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# THE PRIVATE SECTOR IN SOLID WASTE MANAGEMENT A PROFILE OF ITS RESOURCES AND CONTRIBUTION TO COLLECTION AND DISPOSAL

## VOLUME 1. EXECUTIVE SUMMARY

## VOLUME 2. ANALYSIS OF DATA

APPLIED MANAGEMENT SCIENCES, INCORPORATED
SILVER SPRING, MARYLAND

PREPARED FOR
ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D. C.

1973

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Volumes 1 and 2

**U.S. ENVIRONMENTAL PROTECTION AGENCY**

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This study, for the first time, provides an authoritative description of the private sector contractor involved in the collection of solid wastes from residential, commerical, and industrial sources. No comprehensive national information previously existed depicting this industry in gross terms or specific characteristics. Review of all study data reveals a dynamic and changing industry that is larger, more vigorous, and making a significantly more important contribution to the solid waste management collection and disposal system than previously assumed.

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# THE PRIVATE SECTOR IN SOLID WASTE MANAGEMENT
## A Profile of its Resources and Contribution to Collection and Disposal

Volume 1, Executive Summary
Volume 2, Analysis of Data

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1973

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# INTRODUCTION

The private sector in the field of solid waste management has, until this time, never been quantitatively described in terms of its structure, scope, and contribution to the resolution of the nation's collection problems. This study provides that description on an authoritative basis. It focuses on the private sector contractor involved in the collection of solid wastes from residential, commercial, and industrial sources.

The need to more fully understand the role of the private contractor was, in great measure, stimulated by the current concern for the environment. In response to this need, the Office of Solid Waste Management Programs (OSWMP) of the Environmental Protection Agency (EPA) in June of 1969 provided a grant to the National Solid Wastes Management Association (NSWMA) for the purpose of surveying private solid wastes contractors throughout the nation to profile their organizations and activities, and to statistically analyze and report the data to provide a basis for policy-oriented decision making.

This study, completed for NSWMA by the principals and staff of Applied Management Sciences, concerns the resources and contribution of the private sector. Resources can, in this context, be described as the men and equipment involved in the private contractor sector. Contribution is, in its simplest terms, the "share" of the residential, commercial, and industrial market served by private contractors.

The description and analysis of "resources and contribution" are the major issues addressed. These are, in fact, made up of a series of sub-issues. Within the framework of "resources" consideration is in the number and types of trucks and men; sub-issues extend to measurements of utilization and relative efficiency and how these characteristics are affected by size, customer type, contractual relationships, etc. "Contribution" is essentially a description of what the private sector collects, how much they collect, and from whom. The study results relate the proportion of the market served and the gross output of the private sector. Contribution also considers issues such as type and quality of service.

This study is based on the completion of 2014 personal interviews with private contractors throughout the nation. Of those interviews, 1000 were drawn using a two-stage cluster sample and are projectable within reasonable limits to national total. Most of this report is based on those 1000 interviews. The balance of the interviews are supportive in nature and will be used for future research.

This report is presented in three volumes. This, the initial volume, briefly summarizes the results. Volume 2 is more extensive and provides a description of the methods used in Chapter 2, and in Chapters 3-7, analyzes the data in detail. Volume 3 contains the base tables from which all analysis has been drawn.

This study, for the first time, provides an authoritative description of the private sector contractor involved in the collection of solid wastes from residential, commercial, and industrial sources. No comprehensive national information previously existed depicting this industry in gross terms or in specific characteristics. Fulfillment of the description of the private sector of this industry is the primary objective of this large-scale undertaking. Review of all study data reveals a dynamic and changing industry which is larger, more vigorous, and making a significantly more important contribution to the solid waste management collection and disposal system than previously assumed.

# THE PRIVATE SECTOR IN SOLID WASTE MANAGEMENT - A Profile of its Resources and Contribution to Collection and Disposal

## Volume 1, Executive Summary

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## SUMMARY AND HIGHLIGHTS

The private sector of solid waste management represents a significant portion of the total field in terms of its resources and its contribution to the collection process. There are approximately 10,000 firms operating 62,000 vehicles and employing 102,000 persons. In residential collection, the private sector serves approximately 109 million people in 35 million housing units. Over 90 percent of the commercial/industrial wastes are handled by private contractors. The private sector collects, through either direct customer contracting or government franchising or contracting, 73 percent of the nation's estimated total solid waste tonnage.

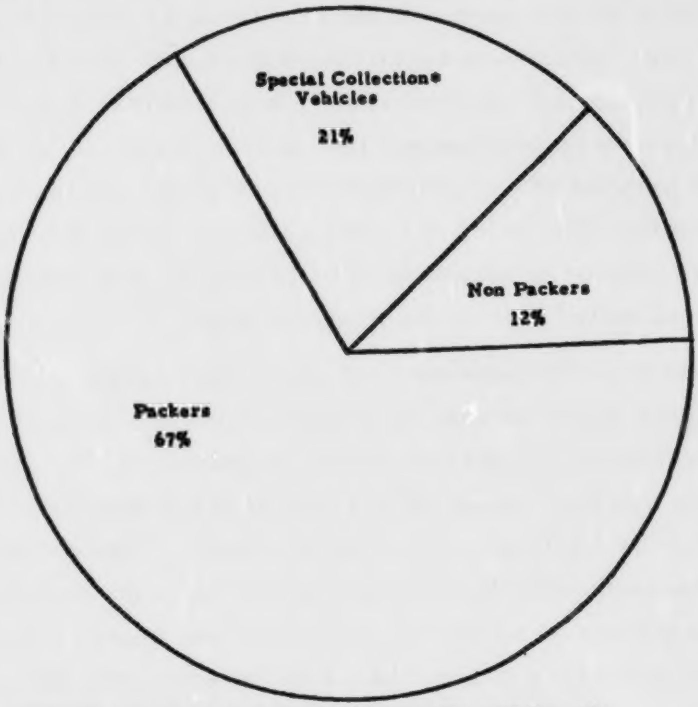
This industry is characteristic of most other large industries in the nation; a relatively small number of organizations hold a major portion of the market. Generally, 15 percent of the companies (1500) collect about 75 percent of the tonnage, serve 62 percent of the customers, and operate about one-half of the total vehicles in the industry. These contractors operate highly mechanized collection equipment and have the highest utilization or efficiency as measured by the ratios of tons per truck or tons per man crew. The 5700 operators of less than 3 or fewer trucks affect waste collection to a lesser degree, since they serve only 10 percent of the customers and collect a similar proportion of the total tonnage.

To a very large extent, private contractors operate packer trucks and special collection vehicles. Less than 15 percent of the vehicles presently operated by full-time contractors are open non-packer-type trucks.

This summary describes the resources and contribution of the private sector in terms of the equipment, manpower, customers served, and tonnage of wastes handled.

## RESOURCES OF THE PRIVATE SECTOR

The 62,000 vehicles operated by private contractors are distributed among three basic types. Figure 1.1 illustrates the average fleet composition as being two-thirds packer vehicles, one-fifth special collection vehicles, and the balance open non packers. Trend data in the survey shows a rapid growth in fleet size between 1965 and 1970 in terms of the total number of trucks, and also the number of packer type trucks.



*roll-off chassis, hoist type vehicles, satellite vehicles, etc.

FIGURE 1.1: FLEET COMPOSITION OF AVERAGE CONTRACTOR

The distribution of all vehicles in the industry reflects the growth of packers and certain special vehicles, and a decline in the number of open non-packer trucks.

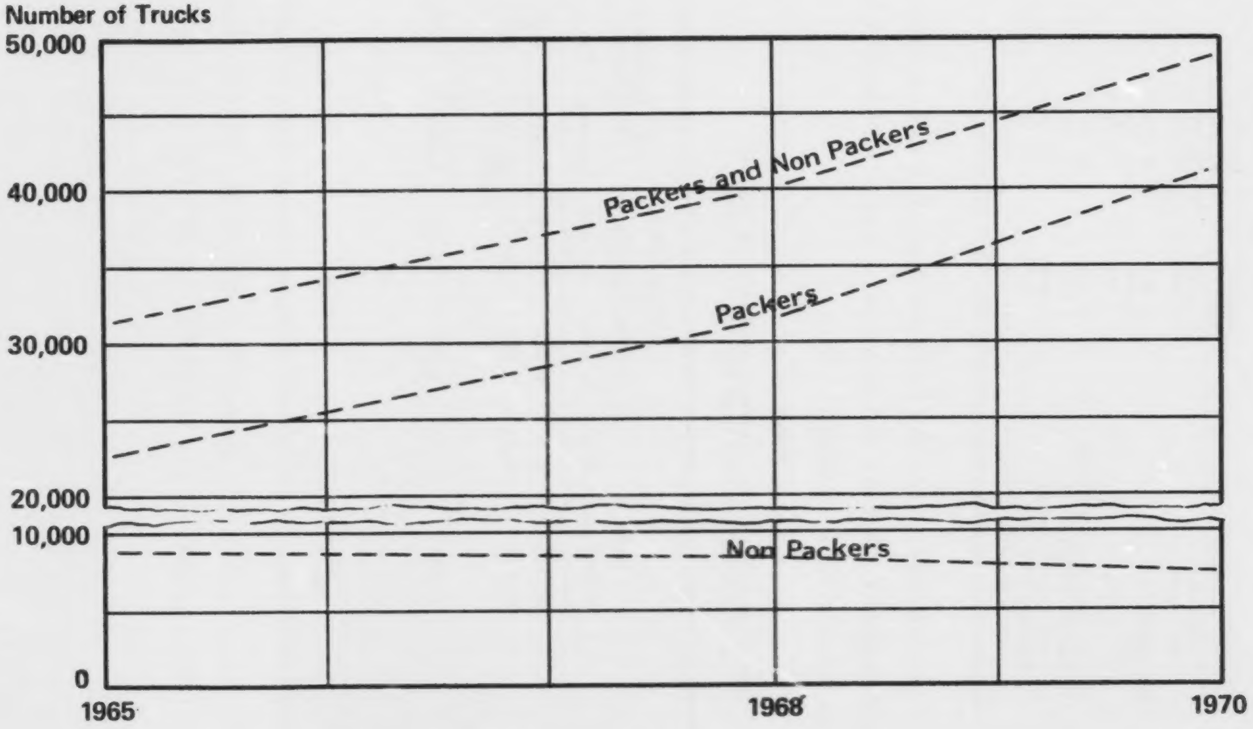


FIGURE 1.2: TRENDS IN OPERATION OF TOTAL PACKER AND NON PACKER TRUCKS IN THE PRIVATE SECTOR

## TABLE 1.1

## NATIONAL ESTIMATE OF TOTAL TRUCKS

| Type of Truck | Number of Trucks | Percent of Total Trucks |
|---|---|---|
| Total Trucks | 61,648 | 100.0% |
| Packers | 41,602 | 67.5% |
| Rear Loaders | 26,230 | 42.5% |
| Front Loaders | 7,670 | 12.4% |
| Side Loaders | 7,702 | 12.5% |
| Non Packers | 7,327 | 11.9% |
| Open | 7,244 | 11.8% |
| Side Loaders | 83 | 0.1% |
| Special Collection Vehicles | 12,736 | 20.7% |
| Roll-off Chassis | 6,496 | 10.5% |
| Hoist Type Vehicles | 2,206 | 3.6% |
| Satellite Vehicles | 2,315 | 3.8% |
| Other Collection Vehicles | 1,719 | 2.8% |

Among the packer vehicles, rear loaders account for two-thirds, with front loaders and side loaders sharing the balance. Approximately one-half of the special vehicles are roll-off chassis.

## TABLE 1.2

## NATIONAL ESTIMATE OF TRENDS IN OPERATION OF PACKER AND NON PACKER TRUCKS IN THE PRIVATE SECTOR

| | Type of Truck | | | | | |
|---|---|---|---|---|---|---|
| | Packers | | Non Packers | | Total Packers and Non Packers | |
| | Number | Percent | Number | Percent | Number | Percent |
| 1965 | 22,739 | 72.1% | 8,784 | 27.9% | 31,523 | 100% |
| 1968 | 31,843 | 79.4% | 8,308 | 20.7% | 40,151 | 100% |
| Percent Change 1965 to 1968 | +40.0% | | -5.4% | | +27.4% | |
| 1970 | 41,602 | 85.0% | 7,327 | 15.0% | 48,929 | 100% |
| Percent Change 1968 to 1970 | +30.6% | | -11.7% | | +21.9% | |
| Percent Change 1965 to 1970 | +83.0% | | -16.1% | | +55.2% | |

To complete the description of equipment, one must consider the various types of specialized equipment serviced by the private sector.

### TABLE 1.3

### NATIONAL ESTIMATE OF SPECIALIZED EQUIPMENT SERVICED BY THE PRIVATE SECTOR

| Type of Equipment | Total Number | Number of Contractors Who Service | Percent of Contractors Who Service | Mean Number Per Contractors |
|---|---|---|---|---|
| Roll-off Bodies | 109,151 | 2,084 | 20.8% | 52.4 |
| Roll-off Chassis | 6,496 | 2,084 | 20.8% | 3.1 |
| (Ratio of Bodies to Chassis) | 16.8 | | | |
| Stationary Containers | 1,783,876 | 6,156 | 61.4% | 289.8 |
| Specially Designed Stationary Containers * | 20,812 | 656 | 6.5% | 31.7 |
| Stationary Compactors | 20.479 | 1,713 | 17.1% | 12.0 |

* Includes sludge containers, acid containers, rubber or plastic lined containers, etc.

While no trend data are available, the less formal evidence assembled by the Applied Management Sciences' study team, and supported by NSWMA staff and members, indicates that a rapid growth has occurred in the number of units of specialized equipment (roll-off bodies, stationary containers, stationary compactors, and special containers) over the past five to ten years.

## CONTRACTOR SIZE

The 10,000 contractors operating in the nation are primarily 1-3 truck organizations. About one-fourth of the companies operate 4-9 trucks, and 15 percent have over 10 trucks. The 1500 largest companies operate 6 out of 10 trucks and collect from approximately 7 of 10 customers served by the private sector. While there are large numbers of small companies, they operate fewer trucks (16% of 62,000) and collect proportionately fewer customers.

Contractor size is a direct result of the tonnage collected and customers served in terms of both types and quantities. The type of truck operated is, to a large extent, determined by the type of waste collected. For example, contractors collecting a large percentage of commercial and industrial wastes operate proportionately more front-end loaders and roll-off units.

Medium size companies (10 to 19 trucks) operated the more sophisticated equipment to a level above our initial expectations (Table 1.4).

TABLE 1.4:

PERCENT OF TOTAL EQUIPMENT OPERATED BY PERCENT OF TOTAL TRUCKS (38%) IN 10-49 TRUCK OPERATIONS

| | % of Total Equipment Operated by Type |
|---|---|
| Rear Loaders | 32% |
| Front Loaders | 45 |
| Side Loaders | 55 |
| Roll-off Chassis | 48 |
| Hoist type Vehicles | 56 |
| Roll-off Bodies | 38 |
| Stationary Containers | 49 |
| Specially designed Stationary Containers | 78 |
| Stationary Compactors | 53 |

Larger firms (50 trucks or more) own an average of 82 vehicles. They have a significantly different vehicle mix than mid-sized firms. The large firms have a greater proportion of rear loaders, which typically have 50 percent less capacity than the front or side loaders. This limits the capacity of the large operator disproportionately when compared to the front-loader oriented mid-sized operator. The large operator has, of course, adjusted his fleet to his mix of customers. His heavy orientation to residential collection prescribes rear loaders as the most efficient mechanism for collection.

In terms of special collection equipment, the large contractor is oriented toward a highly effective use of roll-off chassis and bodies. While owning only 17 percent of the roll-off chassis, these contractors service 41 percent of the roll-off bodies in the private sector. This is supported by a small proportion of commercial and industrial customers, with heavy tonnage attributed to each customer. This is also related to demolition and construction waste collection operators, where roll-off bodies are frequently used for longer term on-site storage.

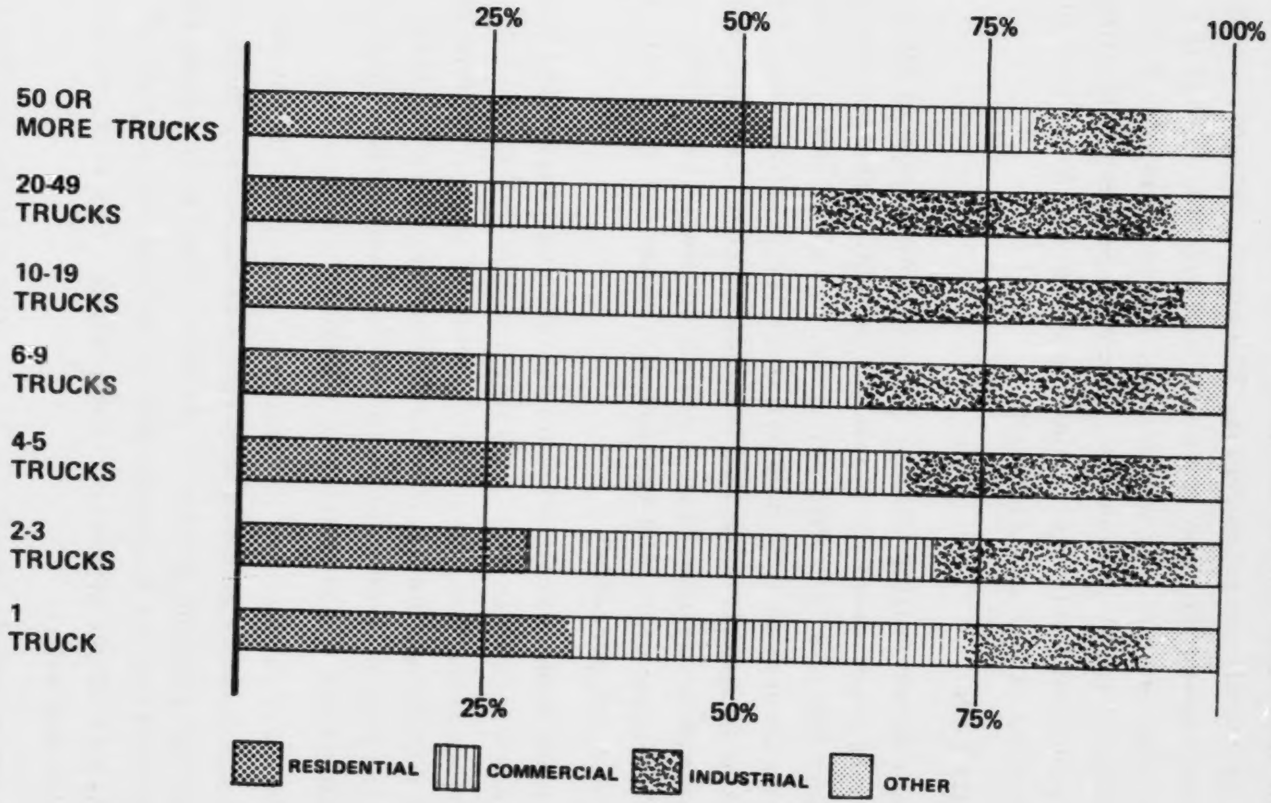


FIGURE 1.3: DISTRIBUTION OF MIX OF TONNAGE COLLECTED WITHIN CONTRACTOR SIZE CATEGORIES

Small contractors, particularly in the 1-3 truck size, represent, for the most part, the individual family business. The statistics reveal these companies to be primarily proprietorships. The small contractor is somewhat more oriented toward the open truck and less oriented toward the specialized collection vehicle. By virtue of his limited capacity, he is more acutely residential and small commercial. Some 46 percent of the single truck operators are exclusively residential; nonetheless, 54 percent of the single truck operators utilize packer trucks.

## MANPOWER UTILIZATION

One of the most interesting findings of this study relates to the crew size used by private contractors in vehicle operations. The average crew size for all vehicle types is 1.59 men per truck, ranging from 1.19 men per truck for front loaders to 1.99 men per truck for rear loaders. Crew size averages exclude special collection vehicles which are generally designed to operate with a one-man crew. Among the total of 102,000 employees, 73.7 percent or 75,000 are directly utilized on the route, leaving the balance as overhead personnel.

A key consideration in examining the number and proportion of collection employees per company is the contractor's mix of collection. As the contractor's tonnage (and, therefore, his customers) tend to become more commercial and industrial, his net number of men per truck reduces. This condition is, of course, a function of the more mechanized equipment used in servicing commercial and industrial accounts.

Since the largest contractors (50 trucks or more), as measured by fleet size, are most heavily involved in residential collection, their fleets tend to contain a high percentage of rear loaders. The larger crew size required on rear loaders, as compared with front loaders and roll-off vehicles, results in a slight increase in the average crew size per truck as contractor size increases.

In total, approximately two-thirds of all private sector personnel are in the employ of the larger organizations which constitute 15 percent of all companies. Due to the types of wastes collected, employees of these organizations tend to operate more mechanized and specialized types of vehicles and, as a result, yield a higher tonnage per employee per truck than personnel of other smaller contractors.

## CONTRIBUTION OF THE PRIVATE SECTOR

An assessment of the contribution of the private contractor must be determined on the basis of the types of wastes collected, tonnages collected, and the customer population served. The customer population is described by residential (single and two to four family housing units) customers, commercial customers (including apartments of five or more units), and industrial customers. The quantity of waste collected is analyzed by both the proportions of the population served and the tonnage collected. What the private sector collects is rather broad. Private contractors collect all forms of wastes on a regular basis. Their type of customer dictates the type of waste they collect.

In total, the private sector collects 73 percent of the solid waste tonnage generated daily in the nation, while serving 51 percent of the residential units and 91 and 94 percent of the commercial and industrial customers, respectively. Merging apartment units into the residential framework, 108 million people residing in 35 million housing units are collected weekly. Almost half of the residential group is served by the private sector under some form of government contract or franchise.

Total collection tonnage handled by the private sector equals 685.5 thousand tons daily. Per capita waste is 8.6 pounds exclusive of agriculture, demolition, and construction wastes. The per capita distribution is 3.9 pounds residential, 2.5 commercial, and 2.2 industrial waste daily. Less than 10 percent of the private sector customers are commercial and industrial establishments, yet, as expected, they account for 65 percent of the tonnage collected.

TABLE 1.5:

TONNAGE SHARES BY CUSTOMER TYPES

| Type of Customer | Percent of total No. of Customers | Daily Share of Tons |
|---|---|---|
| Residential | 90.3% | 21.9% |
| Commercial | 8.3 | 33.7 |
| Industrial | 1.3 | 31.3 |

TABLE 1.6

NATIONAL ESTIMATE - PER CAPITA GENERATION OF RESIDENTIAL, COMMERCIAL, AND INDUSTRIAL REFUSE

| | Total* | Residential | Commercial | Industrial |
|---|---|---|---|---|
| Residential, Commercial, and Industrial Tons Collected by Private Sector on Average Day | 644,511. | 199,132 | 230,865 | 214,514 |
| Share of Residential, Commercial, and Industrial Customers Collected Nationally | 52.4% | 50.2% | 91.0% | 94.0% |
| Residential, Commercial, and Industrial Tons Collected Nationally on Average Day | 878,581 | 396,677 | 253,698 | 228,206 |
| Percent of Total Tonnage | 73.3% | 50.2% | 91.0% | 94.0% |
| National 1970** Population | 203,211,026 | | | |
| Refuse per Person Per Day | 8.6 | 3.9 | 2.5 | 2.2 |

* Total does not include demolition and construction refuse, or other refuse.
** From 1970 Census

## THE PRIVATE SOLID WASTE CONTRACTOR

While over half of the solid waste contractors collect all forms of waste, a significant portion are exclusively involved in the collection of commercial and industrial wastes only. Figure 1.4 on the following page illustrates the total distribution of contractors among customer types. Merging the generalist and specialist contractors, 96 percent collect commercial and industrial waste and 59 percent residential waste.

In terms of business structure, most firms in the industry are proprietorships. This structure is most prevalent among contractors operating less than 5 trucks and collecting less than 50 tons per day. Firms above this level are more likely to be incorporated with at least 75 to 80 percent of the larger firms choosing this form of organization.

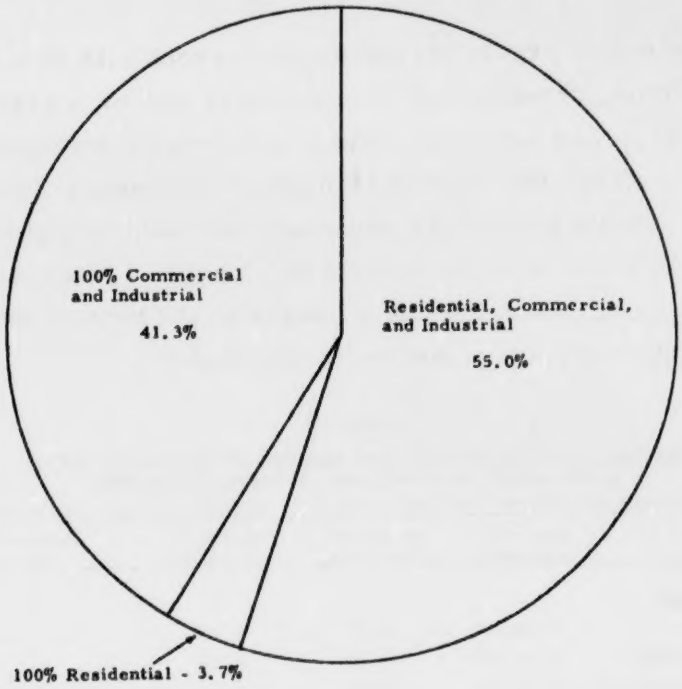


FIGURE 1.4: DISTRIBUTION OF CONTRACTORS AMONG CUSTOMER TYPES

As would be expected, the larger contractor is significantly older than the 13.9 year norm for business operations in the industry. The largest operators have typically operated in their present business form for almost 24 years. Among those contractors whose operations are exclusively residential, almost 1 in 7 began their present business operations during the eighteen-month period from the beginning of 1970 to mid-1971. This compares to an industry norm of 1 in 20 new establishments during the same time frame.

TABLE 1.7

YEAR OF COMPANY ORIGIN IN PRESENT FORM

| Year Started | Total | Percent | Cumulative Percent |
|---|---|---|---|
| 1970-71 | 594 | 5.9% | 5.9% |
| 1965-69 | 2,729 | 27.2 | 33.1 |
| 1960-64 | 2,066 | 20.6 | 53.7 |
| 1950-59 | 2,574 | 25.7 | 79.4 |
| 1940-49 | 1,171 | 11.7 | 91.1 |
| Before 1940 | 831 | 8.3 | 99.4 |
| Don't know | 61 | 0.6 | 100.0 |

Among the major events occurring concurrent with this survey was the apparently strong development of acquisition and/or merger activity by and with firms in and out of the field of solid waste management. During the course of the study, the Applied Management Sciences' field group identified many private contractor organizations that were considering merger or acquisition. It is the contention of Applied Management Sciences that this development was in its initial stages at the time of this survey and is probably not fully accounted for in the study.

TABLE 1.8

NATIONAL ESTIMATE OF CUSTOMERS SERVICED BY THE PRIVATE SECTOR
UNDER DIRECT CONTRACT AND GOVERNMENT FRANCHISE

| Type of Collection | Number of Customers | Percent of Customers | Number of Contractors | Number of Customers Per Contractor |
|---|---|---|---|---|
| **Residential Customers** | | | | |
| Contract Direct | 12,432,149 | 50.3% | 4,906 | 2,534 |
| Government Franchise | 12,284,509* | 49.7% | 1,738 | 7,068 |
| Total Residential Customers | 24,716,758 | 100.0% | 5,883** | 4,201 |
| **Commercial Customers** | | | | |
| Contract Direct | 1,990,083 | 87.2% | 9,055 | 220 |
| Government Franchise | 285,445 | 12.8% | 741 | 385 |
| Total Commercial Customers | 2,275,528 | 100.0% | 9,651** | 236 |

* The original estimate of Government franchise customers was 11,717,509 or 47.4 percent of all residential customers. The 2.3 percent of residential customers unaccounted for was the result of some responding contractors counting a government franchise as one customer and reporting serving one customer under government franchise.

** The number of contractors who contract directly and have government franchises add to more than the total because some contractors operate under both direct contracting and government franchise systems.

The government contracting or franchising mechanism is a common mode of residential operations and a less significant one in commercial collection. While relatively few contractors are operating under government contracts or franchises, they do tend to be very large. The clear majority of the residential customers of 20 or more truck operators are government contract or franchise based.

## TABLE 1.9

### PERCENT OF CUSTOMERS SERVICED BY THE PRIVATE SECTOR UNDER DIRECT CONTRACT AND GOVERNMENT FRANCHISE WITHIN CONTRACTOR SIZES

| Type of Collection | Size of Contractor | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 truck | 2-3 trucks | 4-5 trucks | 6-9 trucks | 10-19 trucks | 20-49 trucks | 50 or more trucks | Total |
| **Residential Customers** | | | | | | | | |
| Direct Contract | 60% | 61% | 83% | 66% | 52% | 26% | 46% | 50% |
| Government Franchise | 40 | 39 | 17 | 34 | 48 | 74 | 54 | 50 |
| Total Residential Contractors | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| **Commercial Customers** | | | | | | | | |
| Direct Contract | 86% | 96% | 98% | 91% | 88% | 75% | 86% | 87% |
| Government Franchise | 14 | 4 | 2 | 9 | 12 | 25 | 14 | 13 |
| Total Commercial Customers | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |

Franchising of commercial and industrial customers appears to occur more frequently where residential franchising occurs. In this context, it is evident that the larger residentially oriented contractors who acquire the major government contracts often serve the bulk of the commercial and industrial franchised customers.

Residential contractors with government franchises are heavily concentrated in SMSA's over one million. Among the 1853 residential contractors located in these areas, approximately half operate in whole or part under some form of government contract franchise. Four regions, the North Atlantic, Mid-Atlantic, Mid-west, and West, have the highest number of customers served and the largest proportion of contractors operating under franchise conditions.

## CHARACTERISTICS OF THE COLLECTION FUNCTION

All forms of wastes are collected by private contractors with the larger organizations handling various unique types such as abandoned vehicles, dead animals, etc.

### TABLE 1.10

### SIZE OF CONTRACTOR INDICATORS BY TYPE OF WASTES COLLECTED IN PRIVATE SECTOR

| Type of Waste | Number of Contractors Who Collect | Percent of Contractors Who Collect | Mean Number of Trucks | Mean Number of Tons Daily | Tons Per Truck |
|---|---|---|---|---|---|
| Rubbish | 9,950 | 99.2% | 6.16 | 72.29 | 11.4 |
| Garbage | 7,889 | 78.7 | 7.12 | 81.26 | 11.4 |
| Yard Refuse | 7,807 | 77.9 | 6.78 | 76.82 | 11.3 |
| Bulky Wastes | 7,623 | 76.0 | 6.87 | 81.17 | 11.8 |
| Ashes | 6,405 | 63.9 | 7.40 | 88.17 | 11.9 |
| Construction and Demolition Wastes | 5,156 | 51.4 | 7.94 | 102.94 | 13.0 |
| Special Wastes | 3,113 | 31.0 | 9.93 | 152.02 | 15.3 |
| Dead Animals | 1,733 | 17.3 | 10.49 | 127.69 | 12.2 |
| Street Refuse | 1,727 | 17.2 | 11.44 | 146.98 | 12.9 |
| Animal and Agriculture Wastes | 1,587 | 15.8 | 13.59 | 183.55 | 13.5 |
| Sewage Treatment Residues | 394 | 3.9 | 14.09 | 239.85 | 17.0 |
| Abandoned Vehicles | 375 | 3.6 | 15.08 | 220.19 | 14.6 |

The bulk of contractors handle combined collection of residential, commercial, and industrial wastes.

## RESIDENTIAL COLLECTION

Collection from single family households or multi-family dwellings of up to 4 units have been traditionally considered residential. Apartments of 5 or more units have been identified as commercial customers. To allow a complete perspective on residential waste and its collection, we have merged the data into a residential framework only. Within these guidelines, private collection contractors service 35 million housing units and 109 million people.

## TABLE 1.11

## NATIONAL ESTIMATE - SHARE OF POPULATION SERVED BY PRIVATE SECTOR

| | Single Family Homes | Duplexes-4 Units | Total Residential | Apts. 5 or More Units | Total ** Housing Units |
|---|---|---|---|---|---|
| Number of Private Contractors Who Collect | 5,883 | 4,284 | 5,883 | 6,260 | --*** |
| Percent of All Private Contractors (10,027) | 59% | 43% | 59% | 62% | -- |
| Number of Customers Collected By Private Sector | 23,348,933 | 1,367,825 | 24,716,758 | 644,688 | 25,361,466 |
| Estimated Number of Customers Nationally | 46,075,691 | 3,115,747 | 49,191,438 | 678,612 | 49,870,050 |
| Percent of Total Customers Collected By Private Sector | 51% | 44% | 50% | 95% | 51% |
| Number of Units Collected By Private Sector | 23,348,933 | 4,103,475 | 27,452,408 | 7,645,282 | 35,097,690 |
| Number of occupied Units Nationally * | 46,075,691 | 9,347,242 | 55,422,933 | 8,026,814 | 63,449,747**** |
| Percent of Total occupied Units Collected By Private Sector | 51% | 44% | 50% | 95% | 55% |
| Population Collected By Private Sector (3.1 per occupied unit) | 72,381,692 | 12,720,773 | 85,102,465 | 23,700,374 | 108,802,839 |
| Population in Occupied Housing Units | 142,834,642 | 28,976,450 | 171,811,092 | 24,883,128 | 197,399,913**** |
| Percent of Population Collected By Private Sector | 51% | 44% | 50% | 95% | 55% |

* Includes mobile homes and trailers

** Total Housing Units include Residential Units (Single Family Homes and Duplexes to 4 Unit Apartments), and Apartments of five or more.

*** The Number of contractors serving Total Housing Units is unobtainable due to overlap between contractors collecting Residential Units and Apartments.

**** From 1970 Census of Housing.

Large contractors (15.4 percent of the operators and 59.6 percent of the trucks) collect 69 percent of the single-family houses served by the private sector and approximately 80 percent of all multi-family units served by the private sector. The private sector is oriented heavily toward collection in larger SMSA's in providing service to 50 percent of the residential housing units in the nation.

Based on the traditional residential definitions (one to fourplex units), 3.9 pounds of solid waste per capita is generated daily. The 141,000 tons per day handled by large contractors represents 71 percent of all residential waste. A large proportion of residential waste (39%) is further concentrated among about 160 operations of 50 trucks or more.

About 6 out of 10 contractors handle significant quantities of residential waste. As their proportion of residential wastes increases, their proportion of rear and side loader ownership increases. Among those who are exclusively residential, a significantly larger segment of their fleet is in non packers. This indicates that exclusively residential contractors often tend to be small.

Based on trucks in operation, the gross tonnage per truck across the industry equals 14.2 tons daily or 9.1 tons per crew member. This compares with 9.8 tons per truck and 4.7 tons per crew member for those collecting residential wastes only.

## COMMERCIAL AND INDUSTRIAL COLLECTION

Commercial and industrial tonnage accounts for 65 percent of the daily wastes collected by the private sector. Gross weight exceeds 445,000 tons per day. Almost all private solid waste contractors collect some commercial/industrial waste. Applied Management Sciences estimates private contractors collect 91 percent of the commercial and 94 percent of the industrial customers throughout the nation. It should be noted that commercial waste includes the 95 percent of the total apartment refuse which is collected by private contractors.

Collecting in the commercial/industrial market is significantly different from that of the residential sector. High tonnage is generated from relatively few stops. Service to this market requires the use of the more automated and sophisticated equipment such as front-end loaders, roll-offs, hoist type vehicles, etc. These types of vehicles usually involve on-site containerization of the waste.

Two measures indicate the concentration of commercial/industrial waste collection. In terms of tonnage, 15 percent of the contractors collecting 100 tons per day or more collect 77 percent of the commercial/industrial waste. Size of contractor by truck count indicates that 15 percent (10 trucks or more) of the operators collect 66 percent of the commercial/industrial

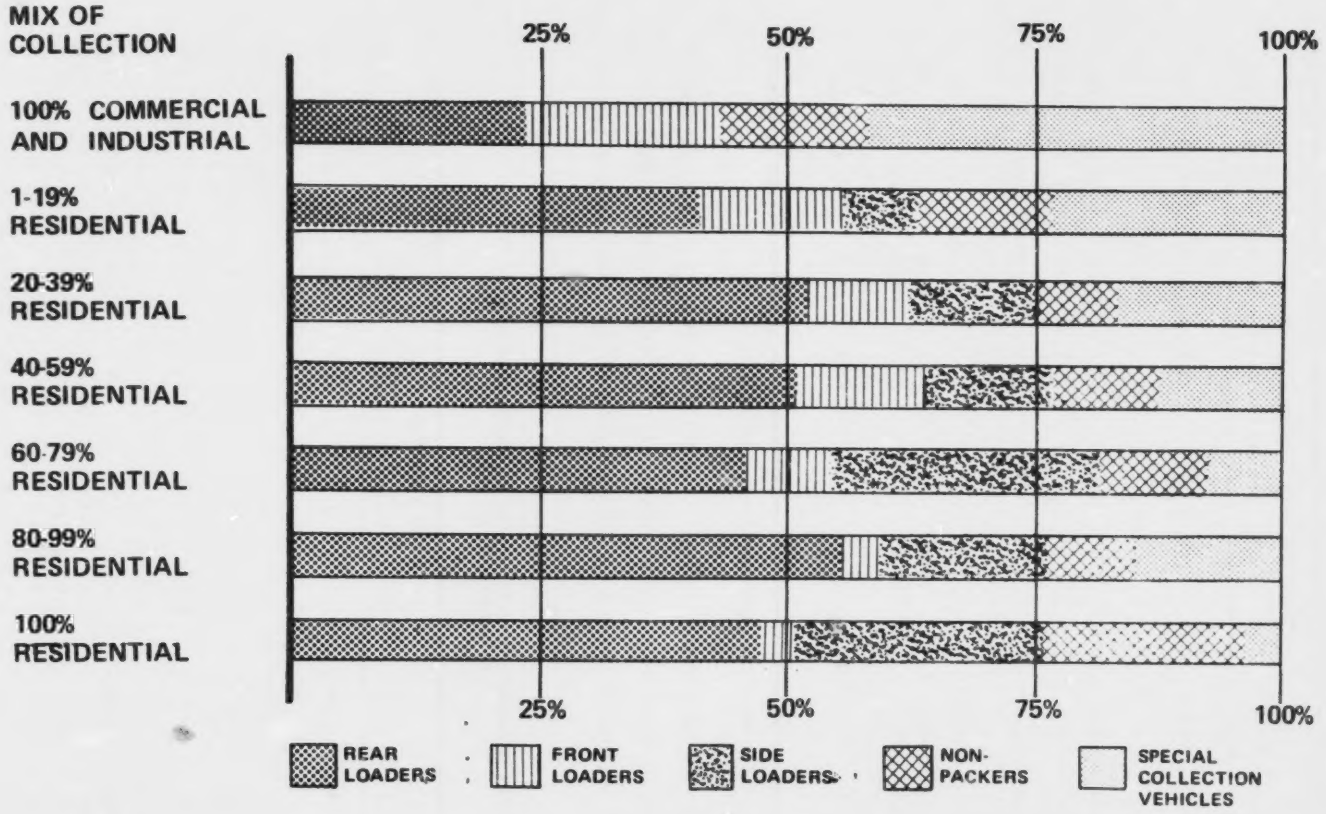


FIGURE 1.5: FLEET CONFIGURATION BY COLLECTION MIX

## TABLE 1.12

### PERCENT DISTRIBUTION OF TONNAGE BY NUMBER OF TONS PER DAY IN THE PRIVATE SECTOR

| Type of Tonnage | Number of Tons Collected Per Day | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1-6 | 7-12 | 13-24 | 25-49 | 50-99 | 100-249 | 250-499 | 500-999 | 1000 or more | Total |
| Distribution of Total Contractors | 26.3% | 17.2% | 18.6% | 12.3% | 11.0% | 9.2% | 2.8% | 1.6% | 1.1% | 100% |
| Distribution of Tonnage Among Number of Tons | | | | | | | | | | |
| Total Tonnage | 1.3 | 2.3 | 4.6 | 6.3 | 10.8 | 20.3 | 13.8 | 15.2 | 25.4 | 100 |
| Residential | 1.8 | 2.6 | 5.9 | 8.2 | 13.1 | 18.8 | 13.5 | 16.9 | 19.2 | 100 |
| Commercial | 1.5 | 3.0 | 5.6 | 6.6 | 11.1 | 21.0 | 13.9 | 17.2 | 20.0 | 100 |
| Industrial | 0.5 | 1.3 | 2.7 | 4.5 | 8.8 | 21.4 | 14.6 | 12.6 | 33.7 | 100 |
| Distribution of Tonnage Within Number of Tons | | | | | | | | | | |
| Total Tonnage | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| Residential | 41.7 | 33.6 | 38.5 | 39.2 | 36.4 | 27.8 | 29.4 | 33.6 | 22.7 | 29.1 |
| Commercial | 40.3 | 45.2 | 41.5 | 36.1 | 35.2 | 35.4 | 34.4 | 38.8 | 27.0 | 33.7 |
| Industrial | 11.7 | 17.5 | 18.1 | 22.0 | 25.0 | 32.3 | 32.5 | 25.4 | 40.9 | 31.3 |
| Other* | 6.3 | 3.7 | 1.9 | 2.7 | 3.4 | 4.5 | 3.7 | 2.2 | 9.4 | 5.9 |

* Other Refuse includes demolition and construction refuse, and all other refuse.

waste. Due to the density of commercial/industrial waste, truck count is not an accurate descriptor of the collection contribution. Obviously, some organizations that are small in terms of truck count collect large tonnage in this marketplace.

## TABLE 1.13

### PERCENT DISTRIBUTION OF TONNAGE BY CONTRACTOR SIZE IN THE PRIVATE SECTOR

| Type of Tonnage | Size of Contractor | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 truck | 2-3 trucks | 4-5 trucks | 6-9 trucks | 10-19 trucks | 20-49 trucks | 50 or more trucks | Total |
| Distribution of Total Contractors | 26.0% | 31.8% | 14.1% | 12.6% | 9.8% | 4.0% | 1.6% | 100% |
| Distribution of Tonnage Among Contractor Sizes | | | | | | | | |
| Total Tonnage | 2.1 | 8.0 | 7.0 | 14.8 | 26.4 | 25.2 | 16.5 | 100 |
| Residential | 2.4 | 8.0 | 6.2 | 12.0 | 22.7 | 19.8 | 28.8 | 100 |
| Commercial | 2.5 | 9.5 | 7.9 | 16.2 | 25.6 | 25.2 | 13.0 | 100 |
| Industrial | 1.3 | 6.9 | 6.3 | 16.9 | 32.2 | 30.4 | 6.1 | 100 |
| Distribution of Tonnage Within Contractor Size | | | | | | | | |
| Total | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| Residential | 34.2 | 30.0 | 27.0 | 24.5 | 25.8 | 23.6 | 52.5 | 29.1 |
| Commercial | 40.5 | 41.0 | 39.0 | 37.6 | 33.2 | 34.2 | 27.0 | 33.7 |
| Industrial | 18.4 | 26.6 | 28.0 | 35.3 | 37.5 | 37.0 | 11.3 | 31.3 |
| Other* | 6.9 | 2.4 | 6.0 | 2.6 | 3.5 | 5.2 | 9.2 | 5.9 |

*Other Refuse includes demolition and construction refuse, and all other refuse.

Clearly, commercial/industrial collection is most properly identified as the principal activity of the 10-49 truck contractor. These contractors collect 51 percent of the daily commercial load and 62 percent of the daily industrial tonnage. As indicated in the initial section of this analysis, this particular segment of contractors is particularly oriented toward the necessary equipment (front loaders, roll-offs, containers, etc.), to service the commercial/industrial requirements. It should be noted a commercial emphasis is also evident at the level of the 5-9 truck operator, but is greater at the 10-49 truck levels, while the operator with 50 or more trucks is primarily involved in residential wastes.

Commercial/industrial collection reflects the latest mechanized technology of the solid waste field. By virtually every measure, contractors committed wholly to this activity are above the norm in terms of mean number of tons (17.2) per truck per day, as well as mean number of tons (14.8) per man per day. The commercial collection vehicle collects 175 percent of the tonnage of a residential truck with half the crew.

In the final analysis, the private sector serves a majority of the people and (with some regional exceptions) nearly all of the commercial and industrial organizations in the United States.

# THE PRIVATE SECTOR IN SOLID WASTE MANAGEMENT - A Profile of its Resources and Contribution to Collection and Disposal

## Volume 2, Analysis of Data

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# 2

# METHODOLOGICAL APPROACH

## SUMMARY

The study methodology for the survey and analysis of the private sector of the solid waste management industry had several essential elements. The first component consisted of designing a questionnaire to elicit information to support meaningful analyses in terms of the study objectives. The second element involved defining the universe of private solid waste contractors and selecting a sample to provide reliable national estimates. The third segment comprised selecting and training interviewers who could expertly draw the maximum amount of information from the respondents. The fourth element consisted of all the data handling including interviewing, editing, coding, and tabulating. Finally, the last step involved the analysis of the survey data and the collection of secondary data such as housing statistics gathered by the Census to support the study objectives. Each phase of the study design and performance proceeded subsequent to review and approval by the Research Committee of NSWMA and the Office of Solid Waste Management Programs of EPA.

Once the list of contractors was developed, the base sample of 1000 contractors was selected. The sample design for the study incorporated a two-stage stratified cluster method. A description of this design follows:

- Contractors were first stratified by regions of the country: (First stage of stratification)
- Within each region of the country, Standard Metropolitan Areas (SMSA's) were stratified by size: (Second stage of stratification)

- SMSA's within each size stratum and region were listed and clusters (SMSA's) were randomly selected: (Cluster phase).
- The number of contractors to be interviewed within each cluster was determined proportionately with respect to region, city size, and number of contractors in each cluster.
- Contractors to be interviewed were randomly selected from the list in each city.

The goal of the sample design of 1000 interviews was to achieve a 95 percent confidence that the estimates derived from the sample data would not vary by more than plus or minus five percent from the true population values (i. e., those which would have been obtained if a complete census of all contractors had been conducted).

The calculations of national estimates and variances of these estimates for the two stage stratified cluster design require city-by-city information, which was not provided for all questions in the data tabulations. Therefore, calculations were derived on the basis of a solely regional stratification (i.e., assuming contractors were stratified by region and randomly selected within region). As seen in this chapter, these estimates are conservative since they do not take full advantage of the further stratification by city size. Examples of various estimates and accuracy intervals are presented below:

### Proportion of Contractors Collecting From Single Family Houses

There is a 95 percent confidence that the true proportion of contractors serving single family houses is within plus or minus 4.9 percent of 58.2 percent; i.e., between 55.3 percent and 61.1 percent.

### Average Number of Single Family Houses Collected By Those Contractors Serving Such Customers

There is a 95 percent confidence that the average number of single family customers for contractors collecting single family houses is within plus or minus 5.4 percent of 4222; i.e., between 3994 and 4450.

### Proportion of Contractors Collecting Industrial Customers

There is a 95 percent confidence that the true proportion of contractors collecting from industrial customers is within plus or minus 5 percent of 60.6 percent; i.e., between 57.6 percent and 63.6 percent.

### Average Number of Industrial Customers Collected By Those Contractors Serving Such Contractors

There is a 95 percent confidence that the true average number of industrial customers for contractors collecting industrial customers is within plus or minus 17.8 percent of 61.5; i.e., between 50.6 and 72.4.

### Total Number of Tons

There is a 95 percent confidence that the true total number of tons collected by the private sector is within plus or minus 16.2 percent of 685,602; i.e., between 574,535 and 796,669.

### Total Number of Trucks

There is a 95 percent confidence that the true total number of trucks operated by the private sector is within plus or minus 11.4 percent of 61,656; i.e., between 54,768 and 68,544.

### Total Number of Employees

There is a 95 percent confidence that the total number of employees in the private sector is within plus or minus 12.8 percent of 102,179; i.e., between 89,100 and 115,258.

As can be seen, at the 95 percent confidence level, the range of accuracy for these examples is from 4.9 percent to 17.8 percent. The differences between the goal and the achieved levels for certain questions resulted from these factors. First, in the estimates of averages and totals, the few very large contractors have a disproportionate influence. The effect of the large contractors is to skew some distributions such that they are non-normal. The second factor involved in the larger variances was the initial assumption at the start of the survey that, for SMSA's of approximately equal size, the variation in contractor characteristics across SMSA's was minimal. As the field work progressed, it was clear that the handling of solid waste across SMSAps of the same size could vary from all private, to a mix of private and public, to all public. Finally, the third factor involves the statistical phenomenon that as the respondent base for a specific characteristic decreases, the associated relative error normally increases. Thus, for example, the estimate of the number of firms having 50 or more trucks is between 57 and 184, indicating a potential relative error of approximately 50 percent. However, the estimate of the proportion of firms having 10 or more trucks is between 13 percent and 17 percent, indicating an absolute error of only 2 percent. As a result, statements about those firms with 10 or more trucks - the top 15 percent of the sample - are associated with more reliable estimates.

In addition to the base sample, an over-sample of 1000 was designed such that a census or a near census would be conducted in forty of the sample cities. The purposes of the over-sample were to assist in the definition and refinement of the universe, to check on the validity of the base sample design, and to provide more accurate estimates and variances of the estimates. In the assessment of the accuracy of the base sample, data for the key variable of trucks was compared on a city-by-city basis. The result of this comparison showed an excellent correspondence between the distributions of contractors by truck size and between the average number of trucks per contractor. For example, the following Tables 2.1 and 2.2 show the data for Portland and Chicago.

Table 2.1

COMPARISON OF TRUCK COUNTS IN SAMPLE AND OVER-SAMPLE FOR PORTLAND

| Number of Trucks | Number of Contractors in Over-Sample | Number of Contractors in Sample |
|---|---|---|
| 1 | 52 | 7 |
| 2-3 | 28 | 7 |
| 4-5 | 11 | 4 |
| 6-9 | 6 | 1 |
| 10-19 | | |
| 20-49 | | |
| 50 or more | | |
| Average Trucks Per Contractor | 2.2 | 2.5 |

## Table 2.2

## COMPARISON OF TRUCK COUNTS IN SAMPLE AND OVER-SAMPLE FOR CHICAGO

| Number of Trucks | Number of Contractors in Over-Sample | Number of Contractors in Sample |
|---|---|---|
| 1 | 27 | 5 |
| 2-3 | 45 | 11 |
| 4-5 | 30 | 12 |
| 6-9 | 28 | 9 |
| 10-19 | 23 | 6 |
| 20-49 | 11 | 2 |
| 50 or more | 1 | 1 |
| Average Trucks Per Contractor | 7.0 | 7.9 |

Such close matches were obtained in every over-sample city and thus substantiated the reliability of the base sample.

The third purpose of the over-sample was to improve the accuracy of the estimates derived from the sample data. To illustrate this result, calculations of the total number of trucks were performed for both the base sample and for the over-sample.

> Base Sample Estimate of Trucks
>
> There is a 95 percent confidence that the total number of trucks operated by the private sector is between 54,768 and 68,544 and is estimated to be 61,656.
>
> Over-Sample Estimate of Trucks
>
> There is 95 percent confidence that the total number of trucks operated by the private sector is between 59,676 and 68,464 and is estimated to be 64,070.

Thus, as can be seen for the key variable of truck count, the over-sample data provided an opportunity to selectively verify the base sample data with the highly refined near-census data.

This chapter is structured into the following subsections:

- Questionnaire Development
- Sample Design
- Sample Reliability
- Interviewing Technique
- Tabulation Processes
- Data Considerations

## QUESTIONNAIRE DEVELOPMENT

Once the major areas of information of business structure, collection modes, equipment, manpower, and salvage and disposal had been defined, the questionnaire development evolved through an iterative procedure of definition, design, review and pretest, and redesign. The definitional task of this study phase involved the initial design of questions to obtain information in all of the major areas of inquiry. This consisted of the formulation of secondary questions which supported the primary issues.

- What is the business structure?
  - Are solid waste contractors primarily proprietorships or are they going through incorporation?
  - Is solid waste management a highly transient industry or composed of long-established firms?
  - What is the industry experience in merger and acquisition?
  - What other businesses related to solid waste collection are companies engaged in?
  - How does the private sector contract with his customer, directly or through a franchise or government contract arrangement?
- What are the characteristics of the collection function?
  - What types of wastes does the industry collect?
  - How often are various residential wastes collected?
  - How many residential customers do they service?
  - What is the practice concerning curb service?
  - How many commercial and industrial customers do they have?
  - How much wastes do they collect for each class of customer?
- What are the characteristics of the equipment used for collection by the private sector?
  - What are the trends over the past five years in the number of open versus packer trucks?

  - .. How many of each type of open or packer trucks are there in the private sector?
  - .. What are the truck capacities and crew sizes?
  - .. What is the extend of use of innovations and special types of equipment?
  - .. What are the maintenance practices?
- What does the manpower pool in the private sector look like?
  - .. How many people are drivers or helpers?
  - .. What is the supervisorial and administrative manpower level?
  - .. How many men are normally assigned as the truck crew?
  - .. What is the usual workweek length?
- What is the role of the private collector in disposal and salvaging?
  - .. How many disposal sites does the private collector own or operate?
  - .. What is the capacity of private sites?
  - .. What are the burning and covering practices?
  - .. How much of various types of wastes are salvaged?

With these information classes defined, a preliminary set of questions were written to obtain data in all areas. To the extend possible, the first draft of the questionnaire was designed in a manner consistent with the format used in the National Survey.

After several drafts of the questionnaire had been written to ensure completeness and logic, a draft was presented to the NSWMA Research Committee on September 17, 1969, for their review. The result of this review indicated that several areas in the document required further clarification and amplification or needed precise definitions. For example, since one major area of interest was the types of solid waste materials collected by contractors, exact classifications were needed for each waste category. These were defined and formatted as a card to be presented to the respondent.

| | |
|---|---|
| GARBAGE | Wastes from the preparation, cooking, and serving of food<br>Market refuse, waste from the handling, storage, and sale of produce and meats |
| RUBBISH | Paper, cardboard, wood, boxes, rags, cloth, bedding<br>Leather, rubber, metals, tin cans, metal foils, dirt<br>Stones, glass, bottles<br>Other mineral refuse |
| YARD REFUSE | Grass, leaves, yard trimmings |
| ASHES | Residue from fires used for cooking and for heating buildings, cinders |
| BULKY WASTES | Stoves, refrigerators, other large appliances<br>Furniture, large crates<br>Trees, branches, palm fronds, stumps, flotage |
| STREET REFUSE | Street sweepings, dirt<br>Leaves |
| DEAD ANIMALS | Cats, dogs, poultry, etc.<br>Horses, cows, etc. |
| ABANDONED VEHICLES | Automobiles, trucks |
| CONSTRUCTION & DEMOLITION WASTES | Lumber, roofing, rubble, plaster, etc.<br>Pipe, wire, insulation, wood, etc. |
| SPECIAL | Hazardous wastes<br>Security wastes<br>Boiler house cinders, paint sludges, chemical, plastic, and metal scraps and shavings, etc. |
| ANIMAL AND AGRICULTURAL WASTES | Food processing wastes<br>Manures, crop residues |
| SEWAGE TREATMENT RESIDUES | Coarse screenings, grit, septic tank sludge, de-watered sludge |

With these definitions, consistent responses could be obtained from all types of contractors.

Further classification was also required in defining the types of customers from whom the private sector collects. Since the collection of wastes from large apartment buildings is often a single bill rather than bills to individual residents, most collectors consider apartment buildings with five or more units to be commercial. Customer definitions were also printed on a hand-out card to facilitate proper classification.

RESIDENTIAL: Single family, duplexes, and apartments of four or less units

COMMERCIAL: Retail stores, office buildings, banks, service stations, apartments of more than four units, hospitals, schools

INDUSTRIAL: Manufacturing or processing plants

The third major area requiring clarification dealt with the types of trucks and specialized equipment used by the private collector. While most contractors would be clear on the differences between front, rear, and side loader trucks, much confusion would exist between, say, stationary containers and stationary compactors. Since word definitions would be difficult, in addition to being time-consuming, a third card was designed depicting various vehicle types and specialized collection equipment. Through the use of these three cards, the major definitional areas were placed on a consistent basis, and ensured uniform and comprehensive responses on the part of the respondents.

Finally, several other areas of the questionnaire required clarification which could most appropriately be handled by the interviewers after they had been properly instructed. As one example, a distinction was desired between the number of customers and the number of stops these customers represented. Particularly in commercial collection, there exists a possibility that while a contractor may collect from a number of chain stores, he may only bill the owner of all the chains. In this situation, these chain stores represent one customer but several stops. Similarly, for large industrial customers, the contractor may have only one bill, but collect from several plants. Since estimates relating to the number of stops were desirable, both customer and stop information was requested.

An additional subject of interest, and one which has gained more importance since the initiation of this study, concerned the contracting method through which the private sector dealt with their customers. Definitions of franchising and direct contract were provided to assess the degree to which contractors were operating under a franchise agreement with governmental units, whereby the city and county allowed for extended agreements covering specific geographical areas.

The last definitional area which required clarification was the explanation of the number of days in the week which the contractor collected. The intent in this question was to arrive at the number of days which the contractor had trucks out on routes collecting. Thus, if a contractor worked a half day each on Saturday and Sunday, he would be defined as working a six-day week.

While the above issues dealt primarily with the content and wording in several questions, the review process indicated a further problem area which had to be addressed. It was considered essential that the questionnaire be designed in such a manner as to provide a method for verifying the responses of the contractors to certain key questions. The approach to this problem was the design of consistency checks at various points in the questionnaire which solicited identical information in different ways. For the critical issue of fleet sizes, three question techniques were employed. First, the contractor was asked his total compactor and non-compactor fleet sizes and later he was asked to delineate the number of each type of truck he had. Still later, the contractor was asked how many trucks were out collecting, in maintenance, or being held in reserve. Field experience proved that this method was extremely effective in gathering accurate information on trucks.

Furthermore, since other variables, such as employees and tonnages, are highly correlated with the number of trucks, additional consistency checks were incorporated within the document. The following are illustrative:

- The ratio of the total employees out collecting and helping to the total number of trucks out on the routes was compared with the average normal crew sizes on the contractors' trucks.
- The total tonnage collected by a contractor was compared with the capacity of his fleet.

In all, some 23 internal consistency checks were designed for the questionnaire which, in addition to the above variables, dealt with responses on collection frequencies, types and numbers of customers, related business activities, and specialized equipment.

The comments, revisions, and suggested improvements in both the format and the content of the draft were incorporated into the overall design of the questionnaire. The revised document then served as the pretest instrument which was initially tested among large and small contractors in Los Angeles, California; San Francisco, California; Salem, Oregon; and Chicago, Illinois. The primary purposes of this initial pretest were to test overall concepts and contents, to ensure that the questions were understood and relevant to the respondent, and to ascertain the data availability for all types of respondents. As a result of this effort, further revisions were made preparatory to a full-scale pretest effort.

The final pretest effort was conducted in March of 1970 and was performed in 13 Standard Metropolitan Statistical Areas (SMSA's) in four Bureau of the Census regions. In all, 108 interviews were completed in Bridgeport, Connecticut; Boston, Massachusetts; Providence, Rhode Island; Rochester, New York; Albany-Schenectady-Troy, New York; Louisville, Kentucky; Charleston, West Virginia; Charlotte, North Carolina; Greensboro, Winston-Salem, North Carolina; Washington, D. C.; Memphis, Tennessee; and Miami, Florida.

The results of these interviews, while indicating the final refinements in the survey document, provided valuable insight into some of the problems and procedural difficulties which would be encountered during the actual survey. Methods for resolving these problems were formulated during the pretest activity and became part of our interviewers' training program and interviewing manual. Examples of some of the lessons learned are as follows:

- An introductory letter from NSWMA prior to contact by the interviewer was essential
- A strong statement of the purposes of the study and its importance to the private contractor was necessary.
- Assurances of complete anonymity were required.
- Appointments to meet with the respondents were essential and the interviewer had to express a willingness to go anywhere including breakfast diners, coffee shops, the landfills, and the respondents' homes.

These techniques assisted in ensuring an extremely high response rate.

Thus, by the end of the first year's effort, a completely field-tested and final survey document had been prepared and an interviewers' manual had been designed.

## SAMPLE DESIGN

The objective of the sample design for this research was to provide a systematic method for surveying private solid waste contractors to obtain an accurate profile of the solid waste industry. As with any sampling plan, the size of the sample had to be determined and the method of selecting the sample had to be developed. Both of these tasks required some knowledge about the population being sampled in terms of the overall size of the universe and of the important parameters to be measured. At the start of this research, there was no firm estimate of the former and only reasonable estimates of the latter. Thus, the major efforts in the design phase of the sampling procedures were to develop an estimate of the total number of solid waste contractors in the United States and to refine the assumptions about the important parameters to direct the method of sample selection.

### List Development

As noted in the introduction, one of the difficulties associated with this industry was the lack of a precise delineation and listing of the firms engaged in solid waste activities. Since any sampling plan is highly dependent on the size of the universe to be studied, the initial phase of the sampling design period had to be concerned with the development of such a list. In the gathering of the master list of all private contractors throughout the country, three primary sources were used:

- the telephone yellow page directories from all cities in the country;
- license and permit lists issued by municipalities, counties, and states;
- membership lists of National Associations as well as local associations.

Yellow page information was acquired from three sources: the Library of Congress, direct collection of yellow pages from major SMSA's, and a field staff with locations throughout the country. Permit and license list information was gathered by requesting such lists from every city and county seat in the country. Over 3,000 requests were mailed throughout the country, and of those places which had such lists, 600 answered the request. The third source of contractor names and addresses came from the membership file of NSWMA and the membership files of other local associations throughout the country.

The lists from these sources were punched onto computer cards and run through a program that matched/merged the data. In this way, exact duplicative names and addresses were deleted. After computer editing was performed, a manual check of the list was conducted to remove duplications which did not exactly match due to change in spellings or placement of words. In all, 11,330 names of private solid waste contractors were gathered for the definition of the universe.

## Sampling Procedure

The sampling procedure was highly dependent upon the objectives of the survey, the characteristics of the population being sampled, and the resources available. Consideration of these factors led to a two-stage sampling plan for this survey. The first stage consisted of selecting a sample of SMSA's and cities not within SMSA's from the total population of these units. The second stage consisted of selecting contractors within SMSA's or cities. SMSA's have been used as the primary sampling units where such are defined because many times a contractor located in an SMSA serves not only the city in which he is located but other parts of the SMSA as well.

Drawing a sample as described here constituted cluster sampling since contractors were not randomly selected from the total population of contractors, but rather clusters of contractors (SMSA's or cities) were randomly selected and a random sample of contractors was then drawn from the selected cluster. The rationale for using cluster sampling was that it provided administrative efficiency by reducing the number of separate geographical locations which had to be visited.

There was good reason to believe that many of the parameters of the solid waste contractor population being estimated from this survey were directly proportional to city size. Of course, not all of the large contractors are located in large cities, but most of them are. Therefore, efficiencies in sampling could be realized from stratification by population in SMSA's.

Stratification by geographical region was also desirable to account for differences that may exist in different areas of the nation. One difference is the types of industries served by solid waste contractors, which influences the type and mix of solid waste collected. The regions into which the population was stratified were the nine regions defined by the Census Bureau which were used by BSWM in their survey. These regions are shown in Figure 1.

### Sample Size

Since two-stage sampling was being employed, both the number of SMSA's and cities to be visited and the number of completed contractor interviews had to be determined. Both sample sizes depended upon the respective population sizes, the distribution of the population characteristics within SMSA's or cities and among SMSA's or cities, and the types of estimates being made by the survey.

The size of the first-stage population was known. At the start of the study, there were 229 SMSA's in the continental United States and 1,401 cities of greater than 5,000 population that were not in SMSA's.

There were many characteristics being measured by this survey, and little was known about most of them. The variability in some of them may have been greater from SMSA-to-SMSA or city-to-city, and the variability

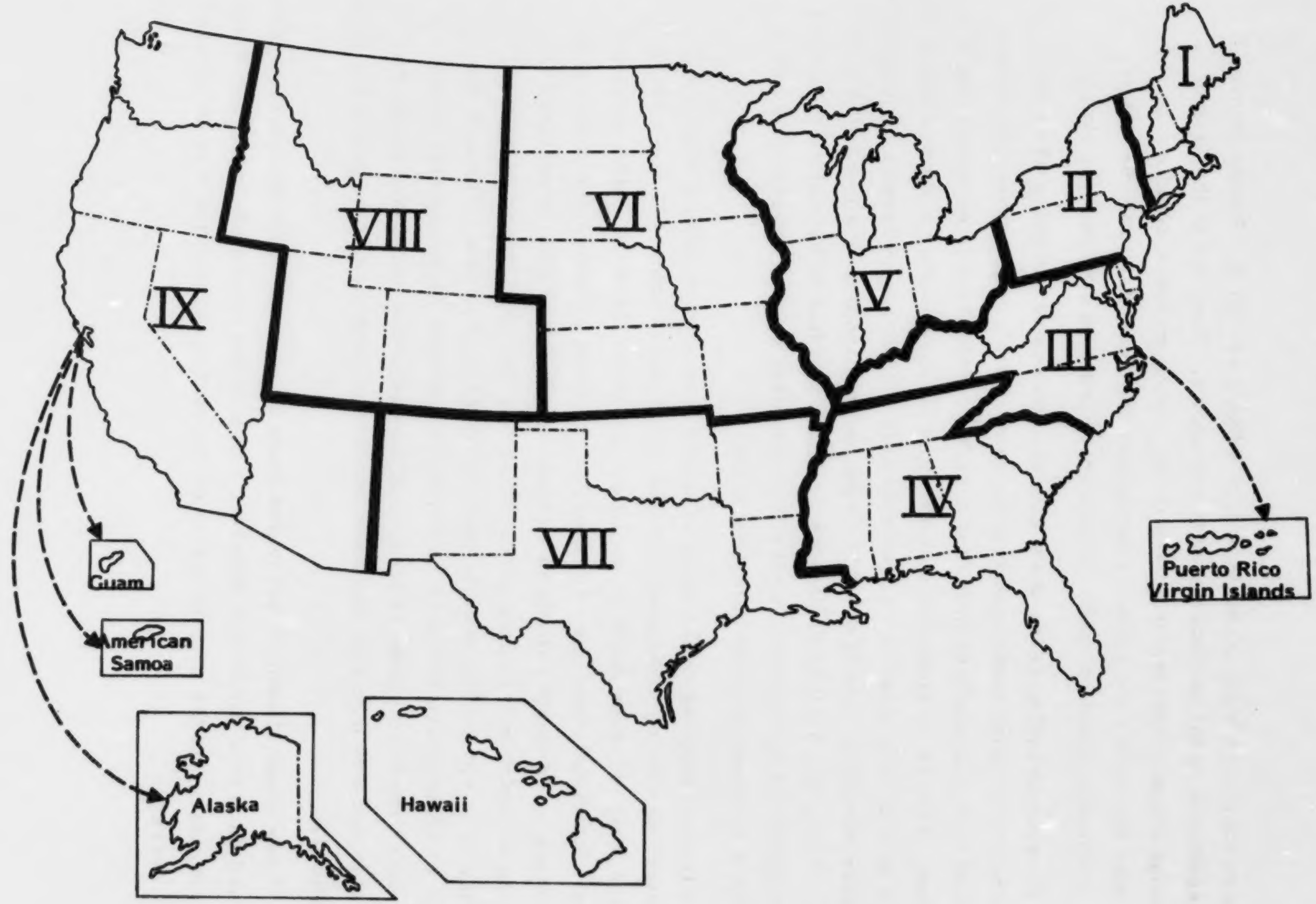
I
II
III
IV
V
VI
VII
VIII
IX
Puerto Rico
Virgin Islands
Guam
American
Samoa
Alaska
Hawaii

FIGURE 2.1: BUREAU OF CENSUS REGIONS

in others may have been greatest within SMSA's or cities. Furthermore, the magnitudes of the variations were not known. Because of the lack of knowledge about characteristic variability, optimum sizes could not be determine for either the primary sample or the secondary sample. However, estimates could be made of the upper limits on both sample sizes.

Cluster sampling is the least effective means of sampling when the characteristics being measured are the same for all contractors within any given SMSA or city and are different only for contractors in different SMSA's or cities. This is so since the sample must be spread over a large number of SMSA's or cities to obtain an acceptable sampling error, whereas the objective of cluster sampling is to take an in-depth sample from only a few SMSA's or cities. Thus, the number of SMSA's or cities that had to be visited to assure an acceptable sampling error under this condition was the maximum number of SMSA's required for this sampling plan.

Cluster sampling is the most effective means of sampling when the characteristics being measured have the same distribution within all SMSA's or cities; that is, when there is no difference from SMSA-to-SMSA or city-to-city. Stratified sampling, however, is the least effective under this condition since an in-depth sample in at least one SMSA or city is required to obtain an acceptable sampling error; whereas, the objective of stratified sampling is to spread the sample over all SMSA's or cities. Thus, if the number of contractors had been calculated to provide an acceptable sampling error under the assumption of stratification under the worst condition, the value obtained would be the maximum number of contractors required for this sampling plan.

Three types of sample estimates were to be made from the questionnaire data, and each type dictated a different computation of sample size. All three were considered in the determination of the contractor sample size to be used in this survey.

- Totals or means of population characteristics (e.g., total amount of waste collected, average number of employees per contractor).
- Proportions of population with given characteristics (e.g., the percent of contractors who collect from single family houses).
- Ratios not expressed directly in terms of the primary population variable, number of private contractors (e.g., percentage of trucks which are compactors, or average number of men per truck.

The sample size dictated by each type was calculated and the implications of using a sample smaller than the maximum of these three is discussed in the following paragraphs.

### Calculation of Number of SMSA's

The maximum number of SMSA's required to ensure an acceptable sampling error for those characteristics of a contractor which have a small variance within SMSA was derived. In making the calculation, proportions were the only type of measure considered since only characteristics with measures of this type are expected to have small variances within cluster. The number of SMSA's was calculated under the following assumptions.

- at least one attribute of the population is characteristic of 50 percent of the sample, and
- ninety percent confidence in a relative sampling variation of ± 10 percent in a 50 percent measurement (± 5 percentage points) is adequate.

Under these assumptions, the sample size was calculated by the formula

$$n = \frac{V^2 N}{N\left(\frac{D}{\bar{a}}\right)^2 + V^2}$$

where

$$V = \frac{S}{\bar{X}} = \text{the coefficient of variation of the characteristic being measured}$$

$$= \frac{Q}{P} = \frac{0.5}{0.5} = 1.$$

$N$ = the total number of SMSA's = 229

$D$ = the acceptable error in the parameter estimate = 0.1.

$a$ = the point on the distribution of the parameter estimator that 10 percent error = 1.65 (in units of standard deviation)

$\overline{X}$ = estimate of the characteristic being measured.

$S$ = standard deviation of the estimate.

Substituting into the equation, we obtained

$$n = \frac{229}{229\left(\frac{0.1}{1.65}\right)^2 + 1}$$

$$= \frac{229}{1.80} = 124$$

## Calculation of Number of Contractors

The maximum number of contractors required to ensure an acceptable sampling error for characteristics with a small variance between SMSA or city were then calculated. The sample size dictated by all three types of measures were calculated and the implications of selecting other than the maximum number were considered.

### Means or Totals

In calculating the upper limit on the sample size for estimating means or totals of population characteristics, assumptions also must be made about the standard deviations of the characteristics being measured and the sampling error that is acceptable. For this plan, the following assumptions have been made:

- No population characteristic has a standard deviation greater than 80 percent of its mean (e.g., the amount of solid waste collected by a single contractor).
- Ninety-five percent confidence [1/] that the estimate of population parameter (e.g., the total solid waste collected by all contractors) is within 5 percent of the true value of the population parameter is adequate.

---

[1/] This means that only 5 percent of the time will the estimate deviate from the parameter by more than 5 percent.

Under these assumptions, the sample size is calculated by the formula

$$n = \frac{V^2 N}{N\left(\frac{D}{a}\right)^2 + V^2}$$

where

$V = \frac{S}{\overline{X}}$ = the average coefficient of variation with SMSA of the characteristic being measured over all SMSA's = 0.8.

N = the population size = 11,330

D = the acceptable error in the parameter estimate = 0.05

a = the point on the distribution of the parameter estimator that represents 5 percent error = 2 (in units of standard deviation).

Substituting into the equation, we obtain

$$n = \frac{0.64 \times 11,330}{11,330\left(\frac{0.05}{2}\right)^2 + 0.64}$$

$$= \frac{7,251}{7.72} \approx 1000$$

Therefore, under the conditions stated, an upper limit of sample size was 1,000 contractors.

Plots of sample size versus the error at both 90 percent and 95 percent confidence for several values of the coefficient of variation are shown in Figure 2. The dotted lines are 90 percent confidence curves and the solid lines are 95 percent confidence curves. Figure 2 shows that, at $S = 0.8\overline{X}$ and 95 percent confidence, increasing the sample size to 2,000 would only reduce the error from 5 percent to 3.5 percent (i.e., we would be 95 percent confident that the estimate would not deviate from the true value by more than 3.5, rather than 5.0 percent). Also, the figure shows the sample sizes required if the coefficient of variation of the characteristic being measured is

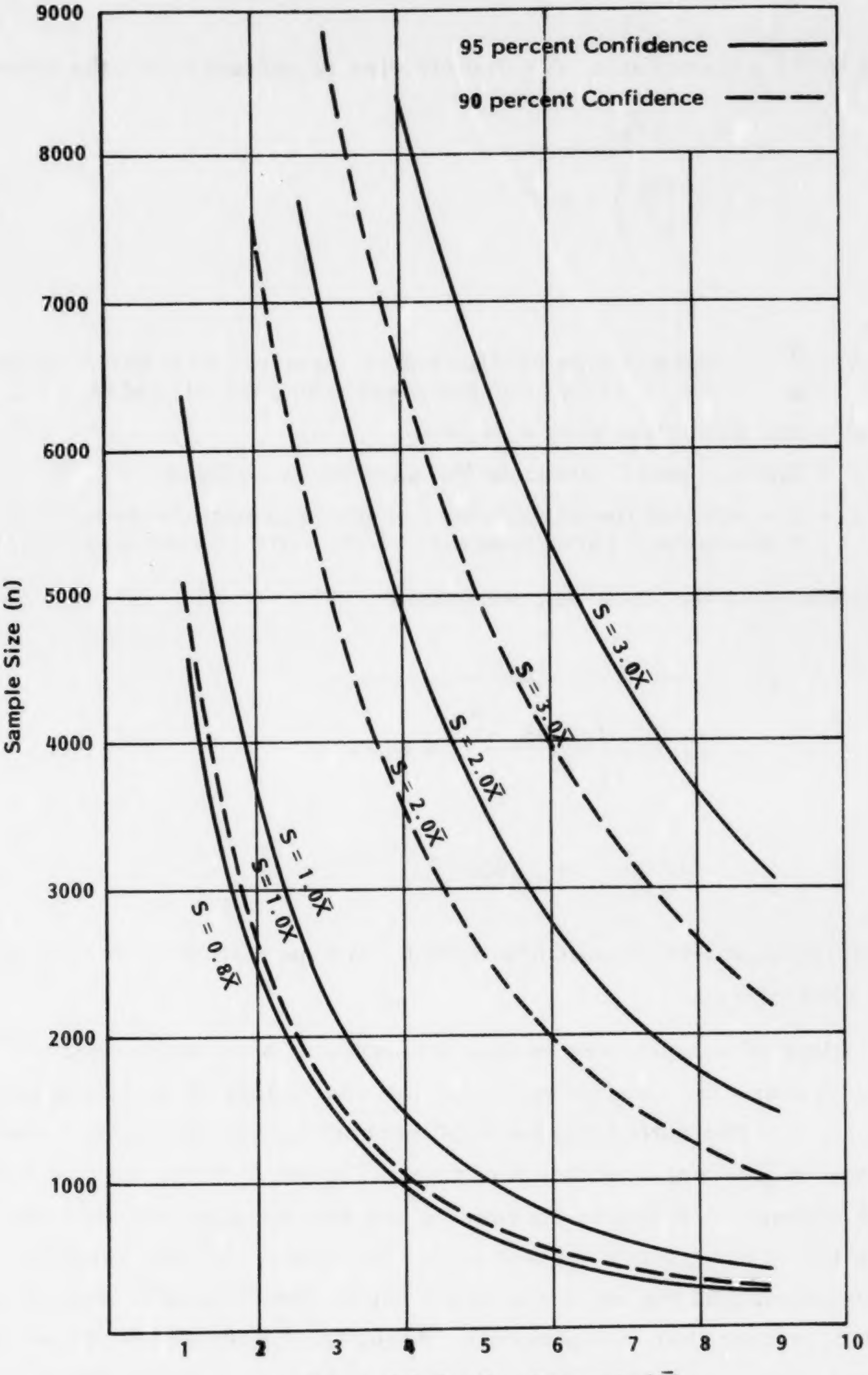

FIGURE 2.2: SAMPLE SIZE VS. ERROR

100, 200, or 300 percent rather than 80 percent of the mean (i.e., $S = 1.0\overline{X}$, $2.0\overline{X}$, or $3.0\overline{X}$ rather than $0.8\overline{X}$). A coefficient of variation of 100 percent would produce a sampling error of 6 percent at 95 percent confidence as compared with 5 percent at a coefficient of variation of 80 percent. Coefficients of variations of 200 and 300 percent would produce errors of well over 10 percent at 95 percent confidence. Errors of this magnitude are unacceptable. Increasing the sample size to 2,000 and requiring only 90 percent rather than 95 percent confidence, the relative error can be maintained at just about 10 percent with a standard deviation of 300 percent.

The sensitivity of the sample size to changes in the size of the population of solid waste contractors was also investigated. Figure 3 shows the results of this investigation. For population sizes between 10,000 and 30,000, a sample of 1,000 is sufficient to obtain parameter estimates within 5 percent. The range in population size corresponds to a variation in number of contractors per million population from 50 to 150.

### Population Proportions

The sample size required to estimate the proportions of the contractor population that have a specified characteristic was calculated under the following assumptions:

- At least one attribute of the population is characteristic of 50 percent of the sample.
- Ninety-five percent confidence in a relative sampling variation of ±5 percent in a 50 percent measurement (2.5 percentage points) is adequate.

The first assumption was made because for a given sample size, the absolute sampling error is maximum for a measured proportion of 50 percent. If the sample size is sufficient to provide 95 percent confidence that the error is within ±2.5 percentage points for a measured proportion of 50 percent, the sample will be sufficient to provide 95 percent confidence that the error is less than ±2.5 percentage points for a measured proportion either greater

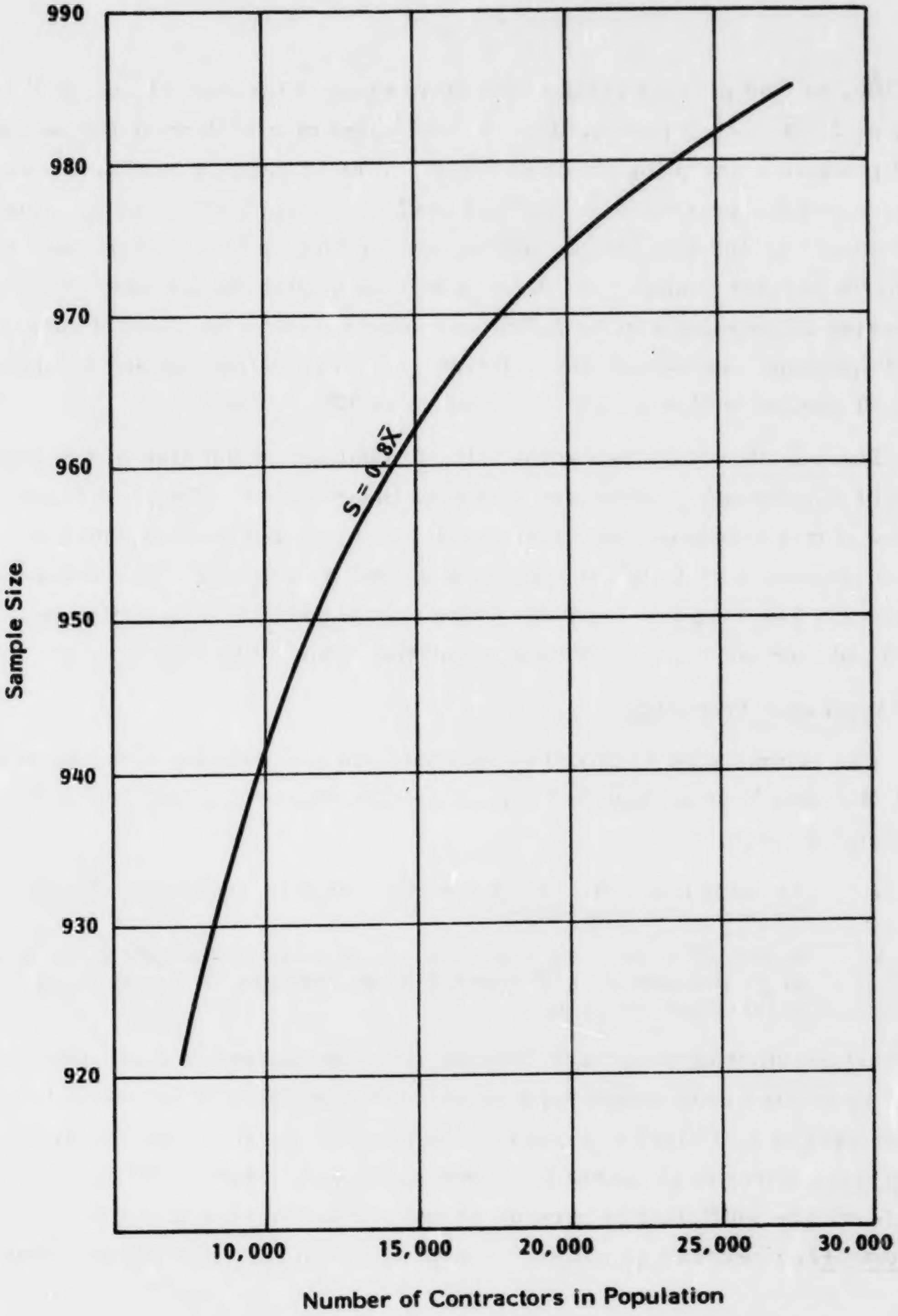

**FIGURE 2.3:** SENSITIVITY OF SAMPLE SIZE TO CONTRACTOR POPULATION SIZE WHEN MEASURING MEANS OR TOTALS

than or less than 50 percent. For example, the error associated with a 20 percent or 80 percent measurement is 2 percentage points (p is between 18 percent and 22 percent or q is between 78 percent and 82 percent) and the error associated 5 percent of 95 percent measurement is within 1 percentage point (p is between 4 percent and 6 percent or q is between 94 percent and 96 percent).

The determination of the sample size necessary to estimate proportions of population characteristics is a special case of the determination of the sample size for the means or totals of population characteristics. Thus, the equation presented earlier was used to calculate the sample size for this case. The difference is that the coefficient of variation of the proportion is calculated by the equation

$$V = \frac{Q}{P} = \frac{0.5}{0.5} = 1$$

where

P = the proportion of the population with the attribute = 0.5

Q = 1 - P = the proportion of the population without the attribute = 0.5

A coefficient of variation of 1.0 placed more stringent requirements on the sample than does a relative variance of 0.8. In estimating proportions, a sample of 1,500 would have been required under the assumptions made. If a sample of 1,000 rather than 1,500 was used to estimate proportions, a measurement of 50 percent would estimate the true proportion with 6 percent (3 percentage points) with 95 percent confidence. A measurement of 20 percent or 80 percent would estimate the true proportion within 2.5 percentage points and a measurement of 5 percent or 95 percent would estimate the true proportion within 1.3 percentage points.

The sensitivity of sample size to contractor population size has been determined and is shown in Figure 4.

### Ratios

If the unit being sampled is a contractor and estimates are to be made of the ratio of two characteristics of the contractor, the sampling with respect

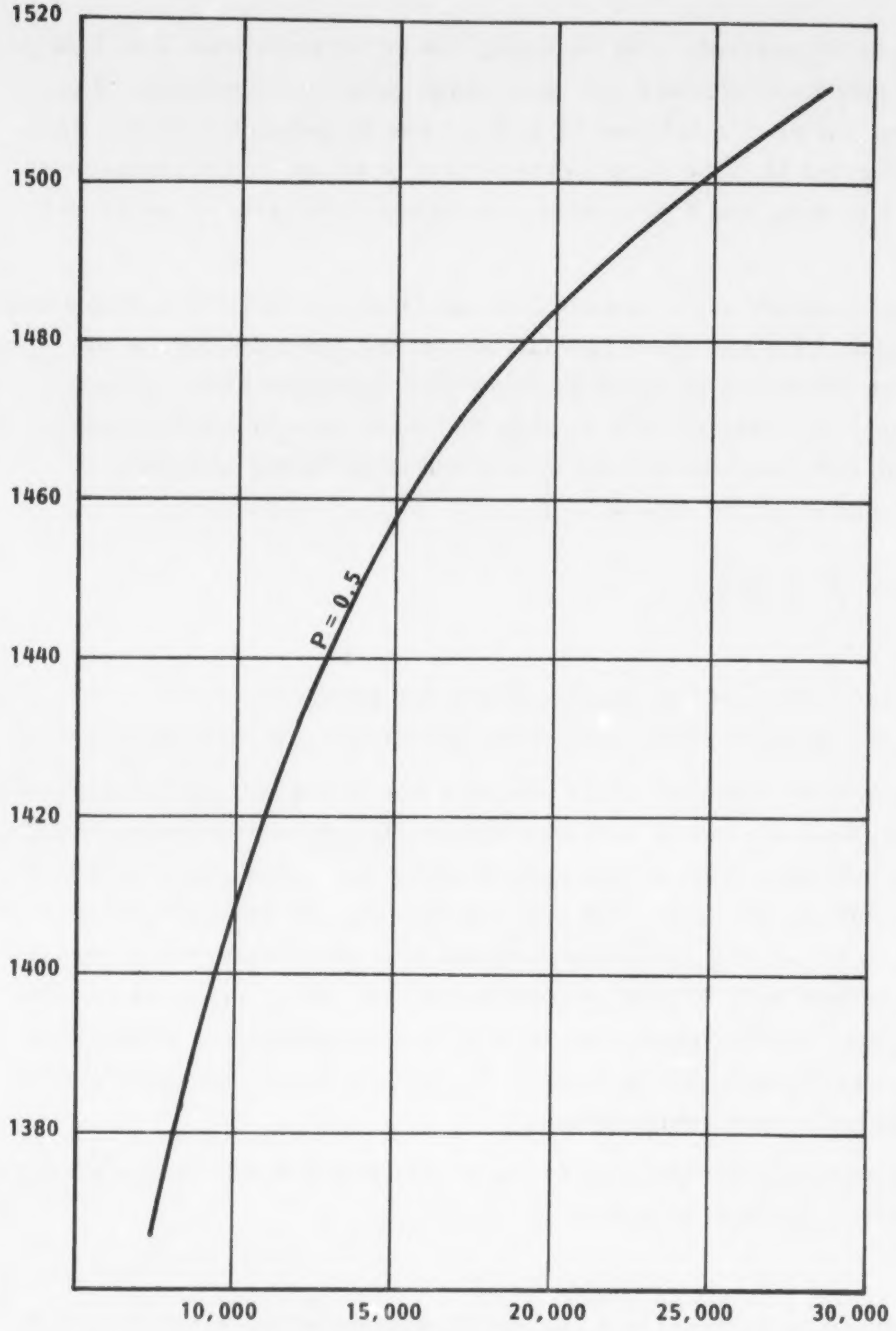

FIGURE 2.4: SENSITIVITY OF SAMPLE SIZE TO CONTRACTOR POPULATION SIZE WHEN MEASURING PROPORTIONS

to the two characteristics is essentially cluster sampling rather than simple random sampling. For example, in estimating the ratio of the number of compactor trucks to the total number of trucks, a random sample of trucks is not selected from the total population of trucks for collecting solid waste, but rather contractors are selected and the trucks owned by these contractors are counted. In general, sampling in this way requires a larger sample than simple random sampling to make estimates of the same precision. Thus, the primary question was whether a larger sample was needed to obtain an acceptable estimate of ratios than was needed to make an acceptable estimate of population proportions.

To calculate the sample size required to estimate ratios, the correlation coefficient of the numerator and denominator of the ratio must be known as well as the coefficient of variation of the numerator and of the denominator. The smaller the correlation, the larger the variation of the ratio from contractor to contractor and thus the larger the sample size required to obtain an estimate of a given precision for the total population of contractors. Since the crew size for a given type of truck is highly correlated with the type of truck, the ratio of crew size per truck should be accurately estimated with a relatively small sample.

The assumptions made in calculating the sample size for ratios were as follows:

- The characteristic in the numerator and the characteristic in the denominator of the ratio were both assumed to have a standard deviation equal to 80 percent of their means.
- No two characteristics comprising a ratio have a correlation smaller than 0.2.
- Ninety-five percent confidence that the interval between ±5 percent of the measurement includes the actual value of the ratio is adequate.

Under the assumptions, the sample size is calculated by the formula

$$n = \frac{\left(V_x^2 + V_y^2 - 2\rho V_x V_y\right) N}{N\left(\frac{D}{a}\right)^2 + \left(V_x^2 + V_y^2 - 2\rho V_x V_y\right)}$$

where the ratio being estimated is $R = \frac{X}{Y}$

$V_x$ = the coefficient of variation of the numerator = 0.8

$V_y$ = the coefficient of variation of the demoninator = 0.8

$\rho$ = the correlation coefficient of X and Y = 0.2

and the remainder of the symbols are as defined previously. The equation for means and totals is a special case of this equation with $V_x^2 + V_y^2 - 2\rho V_x V_y$ replaced by $V^2$. The former expression is the coefficient of variation of the proportion among contractors. If this value is greater than the coefficient of variance of 0.64 for means and totals, then a larger sample size would be required to estimate the ratio with the same precision that a mean or total is estimated with. This is, in fact, the case for

$$V_x^2 + V_y^2 - 2\rho V_x V_y = 1.152$$

and a sample size of

$$n = \frac{11,330 \times 1.152}{11,330 \times .000625 + 1.152} = \frac{13,052}{7.081 + 1.152}$$

$$\approx 1,600$$

If a sample of 1,000 rather than 1,600 is used, the worst ratio will have a precision of only 6.6 percent with 95-percent confidence. The sensitivity of the sample size to population size will be similar to those previously shown for other sample sizes.

In conclusion, it was determined that the sample could be conducted with 1,000 interviews to make inferences about all types of population parameters with a maximum error of 6.6 percent at 95-percent confidence if the stated assumptions hold. Many inferences can be made with only a 5-percent error at 95-percent confidence.

## Sample Apportionment

The first part of the sample apportionment was among Standard Metropolitan Statistical Areas (SMSA's) and cities not in SMSA's. The second part was among contractors within cities.

As the first step in apportioning the sample among the SMSA's, all SMSA's were classified by region and by size of SMSA within region. The stratified population of SMSA's from which the sample was drawn is shown in Table 1. The number of SMSA's drawn from each stratum, while maintaining a proportionate sample of 124 SMSA's is shown in Table 2.

| Region / Population | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| 50,000-99,999 | 4 | - | - | 3 | - | 3 | 7 | 2 | - | 19 |
| 100,000-249,999 | 12 | 4 | 10 | 7 | 23 | 7 | 14 | 5 | 4 | 86 |
| 250,000-499,999 | 3 | 10 | 3 | 11 | 10 | 3 | 9 | - | 10 | 59 |
| 500,000-1,000,000 | 3 | 5 | 5 | 6 | 7 | 1 | 3 | 1 | 3 | 34 |
| over 1,000,000 | 1 | 6 | 2 | 2 | 6 | 3 | 3 | 1 | 7 | 31 |
| TOTAL | 23 | 25 | 20 | 29 | 46 | 17 | 36 | 9 | 24 | 229 |

Figure 2.5: DISTRIBUTION OF NUMBERS OF SMSA's BY POPULATION AND REGION WITHIN CONTINENTAL U.S.

| Region Population | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| 50,000-99,999 | 2 | - | - | 2 | - | 1 | 4 | 1 | - | 10 |
| 100,000-249,999 | 5 | 2 | 6 | 4 | 13 | 5 | 7 | 2 | 2 | 46 |
| 250,000 499,999 | 2 | 6 | 1 | 6 | 5 | 1 | 4 | - | 5 | 30 |
| 500,000 1,000,000 | 2 | 3 | 3 | 3 | 4 | 1 | 2 | 1 | 2 | 21 |
| over 1,000,000 | 1 | 3 | 1 | 1 | 3 | 1 | 2 | 1 | 4 | 17 |
| TOTAL | 12 | 14 | 11 | 16 | 25 | 9 | 19 | 5 | 13 | 124 |

Figure 2.6: DISTRIBUTION OF SAMPLE SMSA's BY REGION AND POPULATION

In drawing the sample of contractors within the selected SMSA's, the contractor list was also classified by region and SMSA size within region. Tables 3 and 4 depict the distribution of contractors which existed at the beginning of the study.

| Region Population | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| 50,000-99,999 | 47 | - | - | 5 | - | 55 | 12 | 1 | - | 120 |
| 100,000-249,999 | 190 | 39 | 52 | 26 | 460 | 84 | 76 | 121 | 40 | 1088 |
| 250,000-499,999 | 224 | 397 | 15 | 66 | 428 | 200 | 235 | - | 145 | 1710 |
| 500,000-1,000,000 | 178 | 217 | 129 | 99 | 434 | 61 | 138 | 39 | 236 | 1531 |
| over 1,000,000 | 93 | 1176 | 370 | 80 | 764 | 436 | 152 | 265 | 1746 | 5082 |
| TOTAL | 732 | 1829 | 566 | 276 | 2086 | 836 | 613 | 426 | 2167 | 9531 |

Figure 2.7: DISTRIBUTION OF CONTRACTORS IN SMSA's BY REGION AND POPULATION

| Population \ Region | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| SMSA | 732 | 1829 | 566 | 276 | 2086 | 836 | 613 | 426 | 2167 | 9531 |
| NON-SMSA | 76 | 335 | 66 | 105 | 406 | 558 | 41 | 97 | 115 | 1799 |
| TOTAL | 808 | 2164 | 632 | 381 | 2492 | 1394 | 654 | 523 | 2282 | 11330 |

Figure 2.8: DISTRIBUTION OF CONTRACTORS BY REGION AND POPULATION

Once the distribution of the universe to various region and city size strata had been accomplished, the next step was to apportion the 1,000 sample interviews. As with the selection of the number of SMSA's, numbers of contractors to be interviewed within each cell were determined based on the proportions of the total number. Tables 5 and 6 show this allocation.

| Population \ Region | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| 50,000-99,999 | 4 | - | - | 2 | - | 5 | 3 | 1 | - | 11 |
| 100,000-249,999 | 17 | 3 | 6 | 4 | 42 | 7 | 8 | 11 | 3 | 98 |
| 250,000-499,999 | 20 | 34 | 1 | 6 | 37 | 18 | 20 | - | 13 | 149 |
| 500,000-1,000,000 | 16 | 20 | 10 | 7 | 38 | 5 | 11 | 3 | 21 | 135 |
| over 1,000,000 | 8 | 104 | 33 | 5 | 67 | 39 | 12 | 23 | 154 | 448 |
| TOTAL | 65 | 161 | 50 | 24 | 184 | 74 | 54 | 38 | 191 | 841 |

Figure 2.9: DISTRIBUTION OF CONTRACTOR SAMPLE IN SMSA's BY REGION AND POPULATION

| Region<br>Population | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| SMSA | 65 | 161 | 50 | 24 | 184 | 74 | 54 | 38 | 191 | 841 |
| NON-SMSA | 6 | 30 | 5 | 9 | 36 | 50 | 4 | 9 | 10 | 159 |
| TOTAL | 71 | 191 | 55 | 33 | 220 | 124 | 58 | 47 | 201 | 1000 |

Figure 2.10: DISTRIBUTION OF SAMPLE CONTRACTORS BY REGION AND POPULATION

The final sampling procedures involved the actual selection of SMSA's within each cell. For example, in Region 1, the Northeast, Boston, Massachusetts is the only SMSA with a population greater than one million, and thus all eight interviews were conducted in this city. In Region 9, West, on the other hand, four out of the seven SMSA's of greater than one million population were randomly selected. The 154 interviews to be conducted in this cell were then divided proportionate to the number of contractors in the four SMSA's. Tables 7 through 15 show the SMSA's and non-SMSA's in which interviewing was conducted, and the number of interviews in each site. Contractors within each city were randomly selected from the total list of contractors which had been developed.

## SAMPLE RELIABILITY

As can be seen from the preceding section on the sample design, there were two major factors which determined the reliability and accuracy of the sample estimates. The first of these was the relationship of the sample size (1000) to the estimate of the total universe (11,330). The second factor was the value of the coefficients of variation and the assumptions made about this value (equaled .8) in the initial design. Neither of these factors were known precisely at the start of the survey. Besides gathering the questionnaire data, two other main objectives of the survey were to gain insight into these two factors.

To accomplish these objectives, an innovative approach was taken. In each cell of the region/city size matrix, one SMSA was randomly selected and a census or near census was performed. Thus, in 40 SMSA's, an average of 76 percent of the contractors were interviewed, and in many cases, all contractors were interviewed. Table 16 shows the SMSA's where over-sampling was performed and the percent of completion. In all, 1,333 interviews were conducted in the over-sample SMSA's.

The purposes of the over-sampling were three-fold. First, each interviewer was instructed before entering each city to contact every name on his list to attempt to complete an interview. At a minimum, the interviewer was to determine if the contractor was still in the solid waste business. In addition, in each over-sample SMSA, the interviewer was to make an exhaustive attempt to determine the undercoverage of the existing list. The interviewer examined license lists, the yellow pages, and any local association list. Also, and of importance, he showed his list to contractors he interviewed to determine if they knew of any businesses which were not on the list. As a result of these efforts, an addition of 13 percent of contractors was achieved.

The second purpose of the over-sample technique was to refine the estimates of the totals and standard deviations of key variables. Since the derivation of the overall totals and variances were to be constructed from the complicated two-stage cluster design, increasing the number of interviews in over a third of the SMSA's would improve these estimates. Thus, in summary, the over-sampling technique served to refine the information required to assess the sampling reliability.

## Figure 2.11

## DISTRIBUTION OF SAMPLE INTERVIEWS IN REGION I

| City Size | No. of SMSA | SMSA's in Sample | Interviews To Be Done | Cities | No. of Contractors | Completed No. of Interviews |
|---|---|---|---|---|---|---|
| 1,000,000 | 1 | 1 | 8 | Boston, Mass. | 62 | 8 |
| 500,000 to 1,000,000 | 3 | 2 | 16 | Providence-Pawtucket-Warwick, R.I.-Mass. | 50 | 10 |
| | | | | Springfield-Chicopee-Holyoke, Mass.-Conn. | 13 | 6 |
| 250,000 to 500,000 | 3 | 2 | 20 | Bridgeport, Conn. | 27 | 4 |
| | | | | Worcester, Mass. | 51 | 16 |
| 100,000 to 250,000 | 12 | 5 | 17 | Brockton, Mass. | 16 | 4 |
| | | | | Lawrence-Haverhill, Mass.-N.H | 22 | 6 |
| | | | | Lowell, Mass. | 2 | 1 |
| | | | | New Britain, Conn. | 6 | 2 |
| | | | | Waterbury, Conn. | 17 | 4 |
| 50,000 to 100,000 | 4 | 2 | 4 | Fitchburg-Leominster, Mass. | 7 | 2 |
| | | | | Meriden, Conn. | 9 | 2 |
| NSMSA | 16 | 2 | 6 | Middletown, Conn. | 15 | 5 |
| | | | | Wallingford, Conn. | 5 | 1 |
| | | | | | | |
| | | | | | | |
| TOTAL | | | 71 | | | 71 |

Figure 2.12

## DISTRIBUTION OF SAMPLE INTERVIEWS IN REGION II

| City Size | No. of SMSA | SMSA's in Sample | Interviews To Be Done | Cities | No. of Contractors | Completed No. of Interviews |
|---|---|---|---|---|---|---|
| 1,000,000 | 6 | 3 | 104 | Philadelphia, Pa. | 184 | 66 |
| | | | | Pittsburgh, Pa. | 137 | 35 |
| | | | | Buffalo, N.Y. | 17 | 3 |
| 500,000 to 1,000,000 | 5 | 3 | 20 | Albany-Schenectady-Troy, N.Y. | 27 | 7 |
| | | | | Rochester, N.Y. | 40 | 7 |
| | | | | Jersey City, N.J. | 16 | 6 |
| 250,000 to 500,000 | 10 | 6 | 34 | Harrisburg, Pa. | 18 | 9 |
| | | | | Johnstown, Pa. | 3 | 2 |
| | | | | Trenton, N.J. | 5 | 3 |
| | | | | York, Pa. | 15 | 8 |
| | | | | Binghamton, Pa.-N.Y. | 6 | 5 |
| | | | | Lancaster, Pa. | 9 | 7 |
| 100,000 to 250,000 | 4 | 2 | 3 | Altoona, Pa. | 2 | 1 |
| | | | | Vineland-Milleville-Bridgeton, N.J. | 5 | 2 |
| 50,000 to 100,000 | -- | -- | -- | -- | -- | -- |
| NSMSA | 30 | 12 | 30 | Middletown, N.Y. | 13 | 4 |
| | | | | Poughkeepsie, N.Y. | 6 | 3 |

## Figure 2.12 (Cont'd)

### REGION II

| City Size | No. of SMSA | SMSA's in Sample | Interviews To Be Done | Cities | No. of Contractors | Completed No. of Interviews |
|---|---|---|---|---|---|---|
| NSMSA | | | | Secaucus, N. J. | 9 | 3 |
| | | | | Danville, Pa. | 6 | 5 |
| | | | | Huntington, Pa. | 5 | 3 |
| | | | | Lakewood, N. Y. | 9 | 1 |
| | | | | Middlesex, N. J. | 7 | 4 |
| | | | | Fairview, N. J. | 4 | 2 |
| | | | | Monticello, N. Y. | 5 | 1 |
| | | | | Cranbury, N. J. | 5 | 1 |
| | | | | East Rutherford, N. J. | 3 | 2 |
| | | | | Newburg, N. Y. | 2 | 1 |
| | | | | | | |
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| | | | | | | |
| | | | | | | |
| TOTAL | | | 191 | | | 191 |

Figure 2.13

## DISTRIBUTION OF SAMPLE INTERVIEWS IN REGION III

| City Size | No. of SMSA | SMSA's in Sample | Interviews To Be Done | Cities | No. of Contractors | Completed No. of Interviews |
|---|---|---|---|---|---|---|
| 1,000,000 | 2 | 1 | 33 | Baltimore, Md. | 92 | 33 |
| 500,000 to 1,000,000 | 5 | 3 | 10 | Louisville, Ky.-Ind. | 28 | 5 |
| | | | | Greensboro-Winston-Salem-High Point, N.C. | 7 | 2 |
| | | | | Richmond, Va. | 19 | 3 |
| 250,000 to 500,000 | 3 | 1 | 1 | Charlotte, N.C. | 6 | 1 |
| 100,000 to 250,000 | 10 | 6 | 6 | Charleston, W. Va. | 5 | 3 |
| | | | | Wilmington, N.C. | 6 | |
| | | | | Lexington, Ky. | 4 | 1 |
| | | | | Durham, N.C. | 6 | 1 |
| | | | | Roanoke, Va. | 2 | |
| | | | | Fayetteville, N.C. | 5 | 1 |
| 50,000 to 100,000 | -- | -- | -- | -- | -- | -- |
| NSMSA | 40 | 2 | 5 | Fredericksburg, Va. | 4 | 2 |
| | | | | Goldsboro, N.C. | 5 | 3 |
| | | | | | | |
| | | | | | | |
| TOTAL | | | 55 | | | 55 |

## Figure 2.14

## DISTRIBUTION OF SAMPLE INTERVIEWS IN REGION IV

| City Size | No. of SMSA | SMSA's in Sample | Interviews To Be Done | Cities | No. of Contractors | Completed No. of Interviews |
|---|---|---|---|---|---|---|
| 1,000,000 | 2 | 1 | 5 | Miami, Fla. | 21 | 5 |
| 500,000 to 1,000,000 | 6 | 3 | 7 | Memphis, Tenn. | 7 | 1 |
| | | | | Jacksonville, Fla. | 14 | 2 |
| | | | | Tampa-St. Petersburg, Fla. | 12 | 4 |
| 250,000 to 500,000 | 11 | 6 | 6 | Greenville, S. C. | 3 | 1 |
| | | | | Columbia, S. C. | 6 | 1 |
| | | | | Augusta, Ga. | 6 | 1 |
| | | | | Orlando, Fla. | 13 | 1 |
| | | | | West Palm Beach, Fla. | 8 | 1 |
| | | | | Chattanooga, Tenn. | 10 | 1 |
| 100,000 to 250,000 | 7 | 3 | 4 | Savannah, Ga. | 4 | 2 |
| | | | | Macon, Ga. | 1 | |
| | | | | Huntsville, Ala. | 5 | 1 |
| | | | | Knoxville, Tenn. | 13 | 1 |
| 50,000 to 100,000 | 3 | 2 | 2 | Tallahassee, Fla. | 1 | 1 |
| | | | | Albany, Ga. | 3 | 1 |
| | | | | | | |

Figure 2.14 (Cont'd)

## REGION IV

| City Size | No. of SMSA | SMSA's in Sample | Interviews To Be Done | Cities | No. of Contractors | Completed No. of Interviews |
|---|---|---|---|---|---|---|
| NSMSA | 14 | 2 | 9 | Ft. Pierce, Fla. | 9 | 2 |
| | | | | Daytona Beach, Fla. | 7 | 7 |
| | | | | | | |
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| | | | | | | |
| TOTAL | | | 24 | | | 24 |

## Figure 2.15

## DISTRIBUTION OF SAMPLE INTERVIEWS IN REGION V

| City Size | No. of SMSA | SMSA's in Sample | Interviews To Be Done | Cities | No. of Contractors | Completed No. of Interviews |
|---|---|---|---|---|---|---|
| 1,000,000 | 6 | 3 | 67 | Indianapolis, Ind. | 70 | 6 |
| | | | | Chicago, Ill. | 225 | 46 |
| | | | | Detroit, Mich. | 196 | 15 |
| 500,000 to 1,000,000 | 7 | 4 | 38 | Akron, Ohio | 122 | 15 |
| | | | | Toledo, Ohio | 15 | 3 |
| | | | | Gary, Ind. | 22 | 3 |
| | | | | Grand Rapids, Mich. | 201 | 17 |
| 250,000 to 500,000 | 10 | 5 | 37 | Canton, Ohio | 144 | 13 |
| | | | | Lansing, Mich. | 61 | 7 |
| | | | | Peoria, Ill. | 23 | 3 |
| | | | | Rockford, Ill. | 13 | 10 |
| | | | | Flint, Mich. | 36 | 4 |
| 100,000 to 250,000 | 23 | 13 | 42 | Muncie, Ind. | 6 | 2 |
| | | | | Racine, Wisc. | 17 | -- |
| | | | | Kalamazoo, Mich. | 17 | 4 |
| | | | | Muskegan-Muskegan Heights, Mich. | 15 | 3 |
| | | | | Springfield, Ohio | 22 | 5 |

## Figure 2.15 (Cont'd)

## REGION V

| City Size | No. of SMSA | SMSA's in Sample | Interviews To Be Done | Cities | No. of Contractors | Completed No. of Interviews |
|---|---|---|---|---|---|---|
| | | | | Hamilton-Middleton, Ohio | 28 | 4 |
| | | | | Ann Arbor, Mich. | 17 | 4 |
| | | | | Decatur, Ill. | 21 | 3 |
| | | | | Saginaw, Mich. | 12 | 2 |
| | | | | Champaign-Urbana, Ill. | 40 | 6 |
| | | | | Anderson, Ind. | 13 | 3 |
| | | | | Mansfield, Ohio | 17 | 4 |
| | | | | Springfield, Ill. | 10 | 2 |
| 50,000 to 100,000 | -- | -- | -- | -- | -- | -- |
| NSMSA | 30 | 14 | 36 | Chilocothe, Ohio | 40 | 6 |
| | | | | Owosso, Mich. | 4 | 4 |
| | | | | Beloit, Wisc. | 10 | 4 |
| | | | | Charleston, Ill. | 10 | 4 |
| | | | | Galesburg, Ill. | 9 | 3 |
| | | | | Michigan City, Ind. | 3 | 3 |
| | | | | Elkhart, Ind. | 1 | 1 |
| | | | | Goshen, Ind. | 2 | 2 |

## Figure 2.15 (Cont'd)

## REGION V

| City Size | No. of SMSA | SMSA's in Sample | Interviews To Be Done | Cities | No. of Contractors | Completed No. of Interviews |
|---|---|---|---|---|---|---|
| | | | | Warsaw, Ind. | 1 | 1 |
| | | | | Logansport, Ind. | 2 | 2 |
| | | | | Bunker Hill, Ind. | 1 | 1 |
| | | | | Kokomo, Ind. | 3 | 3 |
| | | | | Russiaville, Ind. | 1 | 1 |
| | | | | New Castle, Ind. | 1 | 1 |
| | | | | | | |
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| | | | | | | |
| TOTAL | | | 220 | | | 220 |

## FIGURE 2.16

## DISTRIBUTION OF SAMPLE INTERVIEWS IN REGION VI

| City Size | No. of SMSA | SMSA's in Sample | Interviews To Be Done | Cities | No. of Contractors | Completed No. of Interviews |
|---|---|---|---|---|---|---|
| 1,000,000 | 3 | 1 | 39 | Kansas City, Mo. | 59 | 39 |
| 500,000 to 1,000,000 | 1 | 1 | 5 | Omaha, Neb. | 29 | 5 |
| 250,000 to 500,000 | 3 | 1 | 18 | Duluth, Minn. | 29 | 18 |
| 100,000 to 250,000 | 7 | 4 | 7 | Topeka, Kans. | 6 | 1 |
| | | | | Cedar Rapids, Iowa | 22 | 2 |
| | | | | Fargo-Moorhead, N. Dak. | 14 | 1 |
| | | | | Sioux City, Iowa | 35 | 3 |
| | | | | Lincoln, Neb. | 4 | |
| 50,000 to 100,000 | 3 | 1 | 5 | Sioux Falls, S. Dak. | 16 | 5 |
| NSMSA | 25 | 7 | 50 | Manhattan, Kan. | 31 | 8 |
| | | | | Iowa City, Iowa | 4 | 4 |
| | | | | Burlington, Iowa | 18 | 5 |
| | | | | Norfolk, Neb. | 8 | 8 |
| | | | | Fremont, Neb. | 10 | 9 |
| | | | | Grand Island, Neb. | 12 | 7 |
| | | | | Mason City, Iowa | 32 | 9 |
| TOTAL | | | 124 | | | 124 |

Figure 2.17

## DISTRIBUTION OF SAMPLE INTERVIEWS IN REGION VII

| City Size | No. of SMSA | SMSA's in Sample | Interviews To Be Done | Cities | No. of Contractors | Completed No. of Interviews |
|---|---|---|---|---|---|---|
| 1,000,000 | 3 | 2 | 12 | Dallas, Texas | 21 | 8 |
| | | | | Houston, Texas | 49 | 4 |
| 500,000 to 1,000,000 | 3 | 2 | 11 | Fort Worth, Texas | 124 | 10 |
| | | | | Oklahoma City, Okla. | 10 | 1 |
| 250,000 to 500,000 | 9 | 4 | 20 | Beaumont-Port Arthur, Texas | 18 | 1 |
| | | | | Shreveport, La. | 5 | 1 |
| | | | | Tulsa, Okla. | 96 | 15 |
| | | | | Corpus Christi, Tex. | 4 | 3 |
| 100,000 to 250,000 | 14 | 7 | 8 | Lake Charles, La. | 3 | 1 |
| | | | | Lawton, Okla. | 1 | 1 |
| | | | | Ft. Smith, Ark. | 3 | 1 |
| | | | | Amarillo, Texas | 8 | 1 |
| | | | | Galveston, Texas | 6 | 1 |
| | | | | Lafayette, La. | 5 | 2 |
| | | | | Texarkana, Tex. | 1 | 1 |
| 50,000 to 100,000 | 7 | 3 | 3 | Tyler, Texas | 1 | 1 |
| | | | | Sherman-Denison, Texas | 3 | 1 |

## Figure 2.17 (Cont'd)

## REGION VII

| City Size | No. of SMSA | SMSA's in Sample | Interviews To Be Done | Cities | No. of Contractors | Completed No. of Interviews |
|---|---|---|---|---|---|---|
| | | | | San Angelo, Texas | 1 | 1 |
| NSMSA | 12 | 3 | 4 | Victoria, Texas | 23 | 2 |
| | | | | Muskogee, Okla. | 1 | 1 |
| | | | | Wagoner, Okla. | 1 | 1 |
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| TOTAL | | | 58 | | | 58 |

## FIGURE 2.18

## DISTRIBUTION OF SAMPLE INTERVIEWS IN REGION VIII

| City Size | No. of SMSA | SMSA's in Sample | Interviews To Be Done | Cities | No. of Contractors | Completed No. of Interviews |
|---|---|---|---|---|---|---|
| 1,000,000 | 1 | 1 | 23 | Denver, Colo. | 114 | 23 |
| 500,000 to 1,000,000 | 1 | 1 | 3 | Salt Lake City, Utah | 27 | 3 |
| 250,000 to 500,000 | -- | -- | -- | -- | -- | -- |
| 100,000 to 250,000 | 5 | 2 | 11 | Colorado Springs, Colo. | 21 | 7 |
| | | | | Ogden, Utah | 8 | 4 |
| 50,000 to 100,000 | 2 | 1 | 1 | Billings, Mont. | 1 | 1 |
| NSMSA | 15 | 2 | 9 | Ft. Collins, Colo. | 13 | 7 |
| | | | | Greeley, Colo. | 4 | 2 |
| | | | | | | |
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| TOTAL | | | 47 | | | 47 |

## Figure 2.19

## DISTRIBUTION OF SAMPLE INTERVIEWS IN REGION IX

| City Size | No. of SMSA | SMSA's in Sample | Interviews To Be Done | Cities | No. of Contractors | Completed No. of Interviews |
|---|---|---|---|---|---|---|
| 1,000,000 | 7 | 4 | 154 | San Diego, Calif. | 35 | 7 |
| | | | | Los Angeles, Calif. | 450 | 112 |
| | | | | Seattle, Wash. | 37 | 11 |
| | | | | San Francisco, Calif. | 152 | 24 |
| 500,000 to 1,000,000 | 3 | 2 | 21 | Phoenix, Ariz. | 40 | 2 |
| | | | | Portland, Oregon | 150 | 19 |
| 250,000 to 500,000 | 10 | 5 | 13 | Salinas-Monterey, Calif. | 11 | 3 |
| | | | | Oxnard-Ventura, Calif. | 22 | 5 |
| | | | | Bakersfield, Calif. | 18 | 3 |
| | | | | Tacoma, Wash. | 8 | 1 |
| | | | | Tucson, Arizona | 6 | 1 |
| 100,000 to 250,000 | 4 | 2 | 3 | Salem, Oregon | 18 | 2 |
| | | | | Reno, Nevada | 6 | 1 |
| 50,000 to 100,000 | -- | -- | -- | -- | -- | -- |
| NSMSA | 60 | 7 | 10 | Bremerton-Point Orchard, Oreg. | 10 | 3 |
| | | | | Baker, Oregon | 1 | 1 |
| | | | | Pendleton, Oregon | 1 | 1 |

## Figure 2.19 (Cont'd)

## REGION IX

| City Size | No. of SMSA | SMSA's in Sample | Interviews To Be Done | Cities | No. of Contractors | Completed No. of Interviews |
|---|---|---|---|---|---|---|
| | | | | Burns, Oregon | 1 | 1 |
| | | | | Coos Bay, Oregon | 2 | 2 |
| | | | | North Bend, Oregon | 1 | 1 |
| | | | | Springfield, Oregon | 1 | 1 |
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| | | | | | | |
| TOTAL | | | 201 | | | 201 |

The third purpose of the over-sample was to provide a verification procedure through which the estimates made from the sample data could be checked. Since the sample interviews were to be randomly selected from the list of all private contractors in each city, a comparison of the distributions of the sample data versus the over-sample data could be performed to assess any sampling bias. Such procedures were performed and supported the randomness of the sample.

## Definition of the Universe of Private Contractors

At the start of this research, as mentioned, the total universe of private solid waste contractors was estimated to be approximately 11,330. Through the interviewing process, changes in both the total number of contractors and the way the contractors were distributed among regions and city sizes occurred. These changes were due to several factors and followed a natural progression. As the first step, the interviewer attempted to reach the contractors on his list to set up an appointment. If no number was listed for a particular contractor in the white or yellow pages, or by the operator, and if no other contractor knew of his existence, that contractor was listed as not in business. Second, if a contractor was reached but was not a solid waste collector, he was also listed as not in business. Finally, a contractor in the field of solid waste was further screened according to the accepted definition that he devoted at least 75 percent of his time in the field. These types of deletions comprised the major changes in the list. In addition, small changes were due to duplications on the list where in one place the name of the company was given, and in another, the name of the owner appeared, or where both a street address and a post office box number appeared.

## TABLE 2.3

## OVER-SAMPLE SMSA'S

| SMSA | Contractors | Interviews | % Completed |
|---|---|---|---|
| Los Angeles, Ca. | 450 | 350 | 78 |
| Chicago, Ill. | 225 | 165 | 73 |
| Portland, Ore. | 150 | 100 | 66 |
| Denver, Colo. | 114 | 90 | 79 |
| Tulsa, Okla. | 96 | 66 | 70 |
| Baltimore, Md. | 92 | 70 | 76 |
| Boston, Mass. | 62 | 42 | 68 |
| Kansas City, Mo. | 59 | 44 | 75 |
| Champaign-Urbana, Ill. | 40 | 30 | 75 |
| Duluth, Minn. | 29 | 26 | 90 |
| Omaha, Neb. | 29 | 24 | 83 |
| Salt Lake City, Utah | 27 | 24 | 89 |
| Bridgeport, Conn. | 27 | 23 | 85 |
| Colorado Springs, Colo. | 21 | 16 | 76 |
| Miami, Fla. | 21 | 16 | 76 |
| Dallas, Texas | 21 | 15 | 71 |
| Buffalo, N.Y. | 17 | 15 | 88 |
| Sioux Falls, S.D. | 16 | 15 | 94 |
| Jersey City, N.J. | 16 | 10 | 62 |
| Toledo, Ohio | 15 | 14 | 93 |
| Springfield-Chi. Holy. -Mass. -Conn. | 13 | 10 | 77 |
| Rockville, Ill. | 13 | 10 | 77 |
| Salinas - Monteray, Ca. | 11 | 11 | 100 |
| Oklahoma City, Okla. | 10 | 10 | 100 |
| Lancaster, Pa. | 9 | 7 | 78 |
| Greensboro-Winston Salem, N.C. | 7 | 7 | 100 |
| Fitchburg, Leominster, Mass. | 7 | 6 | 86 |

## TABLE 2.3 (Cont'd.)

## OVER-SAMPLE SMSA'S

| SMSA | Contractors | Interviews | % Completed |
|---|---|---|---|
| Memphis, Tenn. | 7 | 6 | 86 |
| Reno, Nevada | 6 | 5 | 83 |
| New Britain, Conn. | 6 | 5 | 80 |
| Charlotte, N.C. | 6 | 4 | 67 |
| Augusta, Ga. | 6 | 4 | 67 |
| Topeka, Kans. | 6 | 5 | 83 |
| Savannah, Ga. | 4 | 4 | 100 |
| Lexington, Ky. | 4 | 3 | 75 |
| Lake Charles, La. | 3 | 3 | 100 |
| Altonna, Pa. | 2 | 2 | 100 |
| Billings, Mont. | 1 | 1 | 100 |
| Tallahassee, Fla. | 1 | 1 | 100 |
| Tyler, Texas | 1 | 1 | 100 |

The number of deletions were calculated by region and by city size and the proportions were used to project the total dimunition of the entire universe. Of the original list, it was estimated that 2,457 or 21.6 percent were no longer in business, leaving 8,873 contractors. However, due to the efforts in the over sampling phase of the study, a 13 percent addition to the reduced list was achieved, leaving a total of 10,027 contractors. Tables 17 and 18 show the estimated distribution.

| Region / Population | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| 50,000-99,999 | 31 | - | - | 10 | - | 94 | 13 | 1 | - | 149 |
| 100,000-249,999 | 171 | 39 | 56 | 46 | 362 | 115 | 38 | 144 | 46 | 1017 |
| 250,000-499,999 | 129 | 351 | 15 | 70 | 374 | 228 | 217 | - | 114 | 1498 |
| 500,000-1,000,000 | 86 | 105 | 125 | 79 | 430 | 29 | 121 | 27 | 309 | 1311 |
| over 1,000,000 | 62 | 1281 | 405 | 45 | 848 | 554 | 92 | 126 | 1043 | 4456 |
| TOTAL | 479 | 1776 | 601 | 250 | 2014 | 1020 | 481 | 298 | 1512 | 8431 |

Figure 2.20: FINAL ESTIMATED DISTRIBUTION OF CONTRACTORS BY REGION AND POPULATION

| Region / Population | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| SMSA | 479 | 1776 | 601 | 250 | 2014 | 1020 | 481 | 298 | 1512 | 8431 |
| NON-SMSA | 50 | 248 | 43 | 123 | 387 | 583 | 26 | 93 | 43 | 1596 |
| TOTAL | 529 | 2024 | 644 | 373 | 2401 | 1603 | 507 | 391 | 1555 | 10027 |

Figure 2.21: FINAL ESTIMATED DISTRIBUTION OF CONTRACTORS BY REGION AND CITY

As the final step in the interviewing process, those contractors in business were classified in terms of establishments. For this study, if several companies were located at the same address and if the records for all companies were combined, these companies were considered to be one establishment. On the other hand, if companies at the same address were run separately and separate financial books were maintained, each company was defined as an establishment. To project to the total universe of contractors (i.e., companies), individual questionnaires were filled out for each company. Tables 19 and 20 show the distribution of establishments by region and city size.

Thus, the output of the first objective of the over-sample phase of the study was a refinement of the estimate of total contractors to be 10,027. This is the number to be used in recalculating the reliability estimates.

| Region<br>Population | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| 50,000-99,999 | 27 | - | - | 9 | - | 82 | 12 | 1 | - | 130 |
| 100,000-249,999 | 150 | 34 | 49 | 41 | 318 | 101 | 33 | 126 | 40 | 892 |
| 250,000-499,999 | 113 | 308 | 13 | 61 | 328 | 200 | 190 | - | 100 | 1313 |
| 500,000-1,000,000 | 76 | 92 | 110 | 69 | 377 | 26 | 106 | 24 | 271 | 1151 |
| over 1,000,000 | 54 | 1124 | 355 | 39 | 744 | 486 | 81 | 110 | 915 | 3909 |
| TOTAL | 420 | 1158 | 527 | 219 | 1767 | 895 | 422 | 261 | 1326 | 7395 |

Figure 2.22: FINAL ESTIMATED DISTRIBUTION OF ESTABLISHMENTS BY REGION AND POPULATION

| Region<br>Population | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| SMSA | 420 | 1558 | 527 | 219 | 1767 | 895 | 422 | 261 | 1326 | 7395 |
| NON-SMSA | 44 | 217 | 38 | 108 | 339 | 511 | 23 | 82 | 38 | 1400 |
| TOTAL | 464 | 1775 | 565 | 327 | 2106 | 1406 | 445 | 343 | 1364 | 8795 |

Figure 2.23: FINAL ESTIMATED DISTRIBUTION OF ESTABLISHMENTS BY REGION AND POPULATION

## Derivation of Variance Formulas

The second factor in the estimate of the levels of confidence and accuracy of the sample values involved the assumptions about the coefficient of variations (S/X). In this formula,"X" is the value of the variable being measured, and can be a mean, a total, or a proportion, and "S" is the standard deviation of the estimate. The coefficient of variation $V = S/X$, is a measure of the dispersion of the sample data.

To calculate the variance of the sample estimates (equals the square of the standard deviation), two methods were employed. The first method utilized a variance formula based solely on regional stratification. That is, this formula assumes that contractors were stratified solely by region, and then selected randomly within region; and does not take into account stratification by city size or cluster sampling within city size strata. This derivation is given below:

### FORMULA 1: VARIANCE BASED ON REGIONAL STRATIFICATION

Let

$i = 1, ---, 9$ be the $i^{th}$ region

$n_i$ = number of sample contractors in the $i^{th}$ region

$j = 1, ----, n_i$ be the $j^{th}$ contractor in the $i^{th}$ region

$x_{ij}$ = value of a parameter for the $j^{th}$ respondent in the $i^{th}$ region

$N_i$ = number of contractors in the $i^{th}$ region

N = total number of contractors in the Nation

Then, the following formulas hold for various estimates:

$$x = \text{national total} = \sum_{i=1}^{9} \frac{N_i}{n_i} \sum_{j=1} x_{ij}$$

$$\overline{x} - \text{national mean} = \frac{1}{N} x$$

$V_x^2$ = variance of the national total

$$= \sum_{i=1}^{9} \frac{N_i}{n_i} \left( \frac{N_i - n_i}{n_i} \right) \frac{n_i}{n_i - 1} \left\{ \sum_{j=1}^{n_i} x_{ij}^2 - \frac{\left( \sum_{j=1}^{n_i} x_{ij} \right)^2}{M_i} \right\}$$

$V_{\bar{x}}^2$ = variance of the national mean

$$= \frac{1}{N^2} \left( V_x^2 \right)$$

The second method of calculation of the variance formula was derived based on the overall two-stage stratified cluster sample design. This formulation takes into account all the sampling steps which are summarized as follows:

- Stratification by region
- Stratification by city size within region
- Random selection of clusters within city size stratum within region.
- Allocation of contractors to selected clusters proportionate to number of contractors in clusters.
- Random selection of contractors within clusters.

Based upon this methodology, the following formula resulted:

## FORMULA 2: VARIANCE BASED ON CLUSTER DESIGN

Let

$i = 1, --- 9$ be the $i^{th}$ region

$j = 1, --- 6$ be the $j^{th}$ city size stratum

$M_{ij}$ = number of cities in the $j^{th}$ city size stratum in region i.

$m_{ij}$ = number of cities in sample from the $j^{th}$ city size stratum in region i.

$N_{ijk}$ = number of contractors in the $k^{th}$ city in the $j^{th}$ city size stratum in region i.

$n_{ijk}$ = number of contractors sampled in the $k^{th}$ city in the $j^{th}$ city size stratum in region i.

$N_{ij} = \sum_{k=1}^{M_{ij}} N_{ijk}$ = total number of contractors in the $j^{th}$ city size stratum in the $i^{th}$ region.

$\overline{N}_{ij} = \frac{N_{ij}}{M_{ij}}$ = average number of contractors per city in the $j^{th}$ city size stratum in the $i^{th}$ region.

$$W_{ijk} = \frac{N_{ijk}}{\overline{N}_{ij}}$$

$x_{ijkl}$ = total number of trucks for the $\ell^{th}$ sampled contractor in the $k^{th}$ city in the $j^{th}$ city size stratum in the $i^{th}$ region.

Then,

$x_{ijk} = N_{ijk} \left[\frac{1}{n_{ijk}} \sum_{\ell = 1}^{n_{ijk}} x_{ijk\ell}\right]$ = total number of trucks for the $k^{th}$ city in the $j^{th}$ city size stratum in $i^{th}$ region.

$x_{ij} = M_{ij} \left[\frac{1}{m_{ij}} \sum_{k = 1}^{m_{ij}} x_{ijk}\right]$ = total number of trucks for the $j^{th}$ city size stratum in the $i^{th}$ region.

$$x_i = \sum_{j=1}^{6} x_{ij}$$ = total number of trucks for the $i^{th}$ region.

$$x = \sum_{i=1}^{9} x_i$$ = total number of trucks for the nation.

To calculate the variance formula, a multi-step process is required and is as follows:

$$\sigma^2_x = \sum_{i=1}^{9} \sigma^2_{x_i}$$ = variance of total number of trucks in country.

$$\sigma^2_{x_i} = \sum_{j=1}^{6} \sigma^2_{xij}$$ = variance of total number of trucks in $i^{th}$ region.

$$\sigma^2_{xij} = N^2_{ij}\, \sigma^2_{\bar{x}_{ij}}$$ = variance of total number of trucks in the $j^{th}$ city size stratum in region i.

$$\sigma^2_{\bar{x}_{ij}} = \left[ \sigma^2_{c_{\bar{x}_{ij}}} + \frac{1}{M_{ij} m_{ij}} \sum_{k=1}^{m_{ij}} \left(W_{ijk}\right)^2 \sigma^2_{\bar{x}_{ijk}} \right]$$

= variance of the average number of trucks per contractor in the $j^{th}$ city size stratum in region i.

$$\sigma^2_{c_{\bar{x}ij}} = \frac{M_{ij} - m_{ij}}{(M_{ij})\,(m_{ij})} \left[ \frac{1}{m_{ij}-1} \sum_{k=1}^{m_{ij}} (W_{ijk}\, \bar{x}_{ijk} - \bar{x}_{ij})^2 \right]$$

where $\bar{x}_{ij} = \left[\sum_{k=1}^{m_{ij}} (W_{ijk}\ \bar{x}_{ijk})\right] \Big/ m_{ij}$

and where $\bar{x}_{ijk} = \frac{1}{n_{ijk}} \sum_{\ell=1}^{n_{ijk}} x_{ijk\ell}$ = average number of trucks per contractor in $k^{th}$ city in $j^{th}$ city size stratum in $i^{th}$ region.

$$= \frac{M_{ij} - m_{ij}}{M_{ij}\ m_{ij}} \ \Big[ \Big( \frac{1}{m_{ij} - 1} \Big) \Big[ \sum_{k=1}^{m_{ij}} \big[ (W_{ijk})\ (\bar{x}_{ijk}) \big]^2 - m_{ij}\ (\bar{x}_{ij})^2 \Big]$$

$$= \frac{M_{ij} - m_{ij}}{M_{ij}\ m_{ij}} \quad \frac{1}{(m_{ij} - 1)} \Big\{ \sum_{k=1}^{m_{ij}} (W_{ijk})^2 \ \Big( \frac{\sum_{\ell=1}^{n_{ijk}} x_{ijk\ell}}{n_{ijk}} \Big)^2 -$$

$$m_{ij} \left[ \left( \frac{\sum_{k=1}^{m_{ij}} \sum_{\ell=1}^{n_{ijk}} x_{ijk\ell}}{\sum_{k=1}^{m_{ij}} n_{ijk}} \right) \right]^2 \Bigg|$$

= variance of the average number of trucks per contractor across clusters in the $j^{th}$ city size.

$\sigma^2_{\bar{x}_{ijk}} = \frac{N_{ijk} - n_{ijk}}{(N_{ijk})\ (n_{ijk})} \left[ \sigma^2_{xijk\ell} \right]$ = variance of average number of trucks per contractor in the $k^{th}$ city in the $j^{th}$ city size stratum in the $i^{th}$ region.

[Within cluster (city) variance of the average number of trucks per contractor]

$$\sigma^2_{xijk\ell} = \frac{1}{(n_{ijk}-1)}\left[\sum_{\ell=1}^{n_{ijk}} (x_{ijk\ell})^2 - \frac{(\sum_{\ell=1}^{n_{ijk}} x_{ijk\ell})^2}{n_{ijk}}\right]$$

= variance of the number of trucks per contractor
in the $k^{th}$ city in the $j^{th}$ city size stratum
in the $i^{th}$ region.
[Within cluster (city) variance]

Combining all of these terms and making the appropriate substitutions, the following results.

$$\sigma_x^2 = \sum_{i=1}^{9} \sum_{j=1}^{6} \left[ \frac{M_{ij}^2}{m_{ij}} \left( \frac{M_{ij} - m_{ij}}{M_{ij}} \right) \left\{ \frac{1}{m_{ij}-1} \left[ \sum_{k=1}^{m_{ij}} \left( \frac{N_{ijk}}{n_{ijk}} \sum_{l=1}^{n_{ijk}} x_{ijkl} \right)^2 - \frac{\left( \sum_{k=1}^{m_{ij}} \frac{N_{ijk}}{n_{ijk}} \sum_{l=1}^{n_{ijk}} x_{ijkl} \right)^2}{m_{ij}} \right] \right\} + \frac{M_{ij}}{m_{ij}} \sum_{k=1}^{m_{ij}} \frac{N_{ijk}^2}{n_{ijk}} \left( \frac{N_{ijk}-n_{ijk}}{N_{ijk}} \right) \sigma^2_{x\,ijkl} \right]$$

## Calculation of Selected Statistics

Based on these formulas, calculations of the coefficients of variation can be performed for selected information in the questionnaire. Since the questionnaire data for each question was cross-tabulated by the variable for regions, Formula 1 can be used for all estimates. Since the data was not tabulated for each city, Formula 2 cannot be used, in general. However, since the data were also cross-tabulated by the tonnage and truck variables, estimates of the variances for these two parameters can be made on a city-by-city basis. Thus, the information that follows contains estimates for a number of variables based on the regional formula and for tons and trucks based on the cluster formula.

## REGIONAL FORMULA 1

Q. 2: Proportion of Firms Operating More Than One Company at its Location

Yes = 14.3%

No = 85.7%

$\sigma p = .010435$

$$V = \frac{.010435}{.143} = .073$$

Thus, there is a 95 percent confidence that the proportion of firms operating more than one company at its location is between 12.2 percent and 16.4 percent.

Q. 2: Average Number of Firms Operated at the Location

$\bar{x} = 1.22$

$\sigma_{\bar{x}} = .019$

$$V = \frac{.019}{1.22} = .016$$

Thus, there is a 95 percent confidence that the average number of firms operated at each location is between 1.18 and 1.26.

Q. 8: Proportion of Contractors Collecting from Single Family Houses

Yes = 58.2%

No = 41.8%

$\sigma p = .014388$

$$V = \frac{.014388}{.582} = .0247$$

Thus, there is a 95 percent confidence that the proportion of contractors collecting from single family houses is between 55.3 percent and 61.1 percent.

Q.8: Average Number of Single Family Houses Collected by Those Who Collect Single Houses

$\bar{X} = 4222$

$\sigma_{\bar{X}} = 113.67$

$$V = \frac{113.67}{4222} = .027$$

Thus, there is a 95 percent confidence that the average number of single family houses collected by those who collect single family houses is between 3995 and 4449.

Q.14: Proportion of Contractors Collecting from Commercial Customers

Yes = 96.67%

No = 3.33%

$p = .0056$

$$V = \frac{.0056}{.9667} = .005793$$

Thus, there is a 95 percent confidence that the proportion of contractors collecting from single family houses is between 95.55 and 97.79.

Q.14: Total Number of Commercial Customers

$X = 2,353,183$

$X = 329,731$

$$V = \frac{329,731}{2,353,183} = .14$$

Thus, there is a 95 percent confidence that the total number of commercial customers served by the private sector is between 1,693,721 and 3,012,645.

Q. 14: Proportion of Contractors Collecting From Industrial Customers

Yes = 60.6%

No = 39.4%

$\sigma_p = .015$

$V = \frac{.015}{.606} = .025$

Thus, there is a 95 percent confidence that the proportion of firms collecting from industrial customers is between 57.6 percent and 63.6 percent.

Q. 14: Average Number of Industrial Customers Collected by Those Who Collect Industrial Customers

$\overline{x} = 61.5$

$\sigma_{\overline{x}} = 5.474$

$V = \frac{5,474}{61.5} = .089$

Thus, there is a 95 percent confidence that the average number of industrial customers collected by those who collect industrial customers is between 50.6 and 72.4.

Q. 17: Total Number of Tons Per Day

$X = 685,602$

$X = 55,231$

$V = \frac{55,231}{685,602} = .081$

Thus, there is a 95 percent confidence that the total number of tons collected by the private sector per day is between 575,140 and 796,064.

Q. 20: Total Number of Trucks

$$x = 61,656$$

$$\sigma_x = 3,498$$

$$V = \frac{\sigma_x}{x} = \frac{3,498}{61,656} = .057$$

Thus, there is a 95 percent confidence that the total number of trucks in the private sector is between 54,768 and 68,544.

Q. 21: Total Number of Employees

$$x = 102,179$$

$$\sigma_x = 6,573$$

$$V = \frac{\sigma_x}{x} = \frac{6,573}{102,179} = .064$$

Thus, there is a 95 percent confidence that the total number of employees working in the private sector is between 89,033 and 115,325.

## STRATIFIED CLUSTER FORMULA 2

The second calculation for tons and trucks was performed utilizing the second formula. To accomplish this, the totals and standard derivations were calculated for each city in the sample. In addition, the variation among cities within each city size stratum were also calculated.

$x$ = total tons = 675,018

$\sigma_x$ = 33,075.9

$V = \frac{\sigma_x}{x}$ = coefficient of variation = 4.9 percent.

Thus, there is a 95 percent confidence that the total number of tons collected by the private sector is between 608,866 and 741,170.

$x$ = total trucks = 62,588

$\sigma_x$ = 2,879

$V = \frac{\sigma_x}{x}$ = coefficient of variation = 4.6 percent.

Thus, there is a 95 percent confidence that the total number of trucks in the private sector is between 56,945 and 68,231.

Finally, the oversample data were used to calculate the estimates for the total truck parameter. Information for each over-sample city was used in place of the sample data for that city, and the calculations were redone. In this case, the following were obtained:

## CALCULATIONS INCLUDING OVER-SAMPLE DATA

$x$ = total trucks - 64,070

$\sigma_x$ = 2,242

$V = \frac{\sigma_x}{x}$ = coefficient of variation = 3.5 percent.

Thus, there is a 95 percent confidence that the total number of trucks is between 59,676 and 68,464.

## Sample Estimates

In assessing the levels of accuracy of the sample estimates, the following statements hold for any type of distribution. The chances are about two out of three that the difference between the survey estimate of X and the results of a complete census of all contractors would be less than the standard deviation (X times V). Similarly, the chances are about 19 out of 20 that the difference would be less than twice the standard deviations, and 99 out of

100 that it would be less than 2.5 times the standard deviation. In other words, there is a 95 percent confidence that the true population value lies between the sample estimate plus or minus twice the standard deviation.

Thus, for the three estimates of total trucks, at the 95 percent level, the following result:

STRATIFIED SAMPLE

TOTAL TRUCKS = 61,656 ± 6888

i.e. between 54,768 and 68,544

For this estimate, there is a 95 percent confidence that the true value is within 11.2 percent of the sample.

CLUSTER SAMPLE

TOTAL TRUCKS = 62,588 ± 5643

i.e. between 56,945 and 68,231

For this estimate, there is a 95 percent confidence that the true value is within 9.0 percent of the sample.

OVER SAMPLE

TOTAL TRUCKS = 64,070 ± 4394

i.e. between 59,676 and 68,464

For this estimate, there is a 95 percent confidence that the true value is within 6.9 percent of the sample value.

These results are excellent and follow the progression to be expected from using a gross approximation of the variance and then a more refined estimate using the actual design characteristics. Finally, the use of the over-sample data provides extremely close estimates due to the comprehensive coverage of the universe.

## INTERVIEWING TECHNIQUE

The conduct of the pretest interviews revealed that the interviewing requirements for this survey were significantly different from the norm. First, it was clear that a businessman-to-businessman approach was necessary to establish the proper rapport with the private contractor. Second, since the vast majority of the respondents were vitally interested in their businesses and the solid waste industry, the interview was facilitated by having an interviewer knowledgeable in the field. Third, since the information requested was technical in nature, interviewers who understood concepts such as maintenance, crew sizes, and routing, for example, were needed. Fourth, due to the complexity of the information required and to the numerous internal consistency checks, a high level interviewer was required. Finally, since contractors were dispersed within an SMSA as well as within a region, there was a need for interviewers who were willing to travel and work at nearly any hour of the day and on weekends.

These criteria dictated the selection of a highly unique interviewing staff for this survey. In addition, since the contemplated interviewer training program was designed to be extremely comprehensive and cover a period of one week, the necessity for limiting the number of training sessions was paramount. This latter condition implied the existence of an interviewing staff willing to travel over extensive areas of the country and for extended periods. In addition, it precluded the creation and training of interviewing staffs throughout the country. Thus, the preliminary set of interviewer selection criteria were as follows:

- Willingness to travel for two week to two month periods.
- Familiarity with trucking and maintenance concepts.
- Some knowledge of and familiarity with interviewing techniques.
- Ability to establish rapport with the respondents.

To meet these characteristics, a staff of retired military men was hired. Each of these men had had recruitment interviewing courses, some knowledge of machinery concepts, and were old enough to portray a business-like approach. Finally, all were used to extensive traveling and were enthused about the opportunity to travel and to get involved in a new industry.

During August and September of 1970, recruitment of interviewers took place and four men were selected from a total of fifteen applicants. Once the men were chosen, a one week training course was conducted by the project staff with participation on the part of the BSWM. The objective of this training period was to thoroughly familiarize the interviewing staff with not only the questionnaire, but also with the field of solid waste management. The following is the outline of training sessions:

## INTERVIEWER TRAINING OUTLINE

### September 21, 1970

Morning:

1. Introduction to study, its purpose and goals
2. Introduction of supervisory personnel
3. General discussion of questionnaire
4. Introduction to equipment

Afternoon:

1. Run through on entire questionnaire by instructor
2. Interviewer practicuum
3. Introduction to sampling procedures

Evening Assignment: Read interviewer's manual

### September 22, 1970

Morning:

1. Quiz on the questionnaire, using incorrectly filled out documents
2. Question and Answer session on interviewer's manual and questionnaire

Afternoon:

1. Review of land disposal site investigation report
2. BSWM film on landfill standards, and presentation by BSWM
3. Question and Answer session on land disposal site investigation

Evening Assignment: Review equipment types and land disposal site investigation report

### September 23, 1970

Morning:

1. Quiz on land disposal site investigation form and equipment types
2. Discussion of sampling problems
3. Second practicuum
4. Appointment and call-back procedures

Afternoon:

1. Edit and coding procedures--emphasis on daily edit on-site
2. Procedure for reporting data to office
3. Trip to landfill

### September 24 and 25, 1970

1. Actual practice interviewing under staff supervision.

The training received by the interviewers was highly effective as evidenced by the extremely low refusal rate within the respondent group, the often reported after hours discussions between contractors and the interviewers, and the high praise from the private solid waste industry in terms of their impression of the interviewers.

Actual field interviewing began in the last week of September, 1970 and ended in May, 1971. Interviewing was conducted on a region-by-region basis so that field and quality control were given schedules to be met. A capsule summary of the procedures is as follows:

- Just prior to the completion of one region, the sample in the next region was selected. A letter from NSWMA was sent to each potential respondent outlining the reasons for and purposes of the study and requesting cooperation.
- Interviewer schedules were designed in such a manner as to minimize travel costs and to equalize the time on the road for each man.
- Completed interviews were mailed daily to the office and immediately checked for completeness and internal consistency.

While in the field, each interviewer was responsible for conducting interviews, setting up the next day's appointments, and for checking each day's work. The first checking procedure was designed to ensure that no major errors were in the documents, and if there were, to be able to contact the interviewer before he left the city of region. In this manner, interviewers were able to recontact respondents while the information was still fresh in their minds.

Although the highest level of confidence and trust had been placed in this type of interviewer, extensive verification procedures were carried out to ensure the validity of the questionnaires. A randomly selected sample of ten per cent of all respondents were contacted by telephone to ascertain not only if the interview had been conducted, but also to check the responses to several key questions in the document. In addition, every respondent was mailed a post-card on which he was asked to indicate whether he had been interviewed. As a result of these procedures, it was concluded that all interviewing had been completed as reported.

## TABULATION PROCESSES

From the initial acquistion of data in the completed questionnaires, several steps had to be undertaken to prepare meaningful tabular outputs upon which analyses could be performed. The questionnaires had to be edited and coded, the data had to be keypunched, and then tabulation plans had to be derived. Each of these phases leading to computer tabulations involved manual procedures so extreme quality control techniques were required.

One determinant of an accurate survey is the completeness and care with which the editing and coding procedures are handled. The major purposes of editing and coding are to:

- Make entries clear, consistently uniform, and comprehensive.
- Reduce "no answers" or incomplete replies with the help of other information found elsewhere in the document.
- Identify areas where additional information is required of the respondent.
- Provide instructions to prepare the document for computer editing.

To accomplish these objectives, an editing and coding manual was designed which contained instructions which outlined the type and format of information to be contained in the responses to each question. The manual specified each step to be followed by the editors in examining each question, and in relating responses of groups of questions.

One major function of the editing which was performed on each document was to check for complete answers and answers to every applicable question. An additional function was to ensure internal consistency in the answers to several questions. For example, if a contractor served single family houses, he should have responded to the question on curb service. Or, if he had indicated that he was also involved in disposal activities, then he should have answered the section on disposal. A further function of the editorial staff was to perform range checks on the data to flag suspicious data. For example, a respondent reporting a crew size of over four men per truck would be held out, or a respondent who indicated he collected more than twenty tons per day with only one truck would be closely examined. Thus, the editing procedures were another method for checking for inadvertent misrepresentation of data.

The editing process was performed by staff members who were thoroughly trained in terms of the questionnaire document and the editing and coding manual. As questionnaires were received in the office, each document was immediately edited. In those cases of errors or missing data which were not major enough to require the field interviewer to recontact the respondent, a telephone contact by the editor was performed.

From the initial acquisition of the survey data as edited and verified questionnaires, the keypunch and computer editing and verification procedures began. Keypunch specifications were written for the survey questionnaire and corresponded to the coding instruction manual. In accordance to standards of the data processing industry, the specifications included alpha and numeric codes, left or right columnar justifications, and card location characteristics. A thirty percent keypunch verification was initially performed, and than a 100 percent verification was performed on a sample of the data.

The next operation was card cleaning and machine editing. As part of this process, every column was checked to ensure that only valid codes appeared. Furthermore, logic checks were performed to ensure that the respondent answered only those questions which were relevant to his company. The final steps in the machine editing process were the performance of consistency checks and range checks. Primarily these checks were those which were too complicated or time consuming to perform in the manual edit. An example of these include checking the sum of all of the various types of trucks against the total given in another question. Finally, the card deck was passed through the computer and all the punches were counted by column to obtain a binary count. This check was the last proof that only valid codes existed in the card deck.

Once these cleaning processes had been completed, the card-to-tape operation was performed whereby the data were constructed according to the tabulation specifications. These specifications included a detailed design of each table in the report, how it was to be derived and presented. The derivation procedure required the specification of the card column and punches which were to be combined to serve as the basic data. The total tabulation process and table format consisted of two types of tabular outputs from which analysis began. The first of these were straight tabulations which were frequency counts and percentages for the total sample. The second were cross-tabulations which showed how the responses varied as a function of several basic demographic or descriptive variables.

The design of the cross-tabulation variables consisted of two steps: determining which variables to use and determining how the selected variables should be presented. In the first case, several potential variables were considered and the following were selected:

- Region of the country
- SMSA size
- Size of contractor in terms of tons collected
- Size of contractor in terms of number of trucks
- Size of contractor in terms of total employees
- Contractors' mix of collection

The first two variables are demographic in nature and were designed to assess variations in contractor characteristics due to regional and city size differences. The next set of three variables provide a means of assessing differences in operations resulting from several proxy variables for size. Finally, the last cross-tabulation variable was considered desirable to assess the effects of different types of customer mixes on the methods of operation.

When designing the categories to be used in the cross-tabulation variables, it is necessary that a sufficient number of respondents appear in each break to allow for statistical comparisons. To accomplish this task, preliminary straight tabulations of the last four variables were performed to assist in this design. These tabulations were examined in the light of providing significant and meaningful breaks. As such, the following classifications resulted:

- TOTAL
  - .. All (1000 respondents = 100 percent of the sample)
- REGION OF THE COUNTRY
  - .. Northeast 71 respondents = 7.1 percent
  - .. North Atlantic 191 respondents = 19.1 percent
  - .. Mid-Atlantic 55 respondents = 5.5 percent
  - .. South Atlantic 33 respondents = 3.3 percent
  - .. Mid-West 220 respondents = 22.0 percent
  - .. North Central 124 respondents = 12.4 percent
  - .. South Central 58 respondents = 5.8 percent
  - .. Mountain 47 respondents = 4.7 percent
  - .. West 201 respondents = 20.1 percent
- CITY SIZE
  - .. Over 1,000,000 445 respondents = 44.5 percent
  - .. 500,000-1,000,000 131 respondents = 13.1 percent
  - .. 250,000-499,999 149 respondents = 14.9 percent
  - .. 100,000-249,999 101 respondents = 10.1 percent
  - .. 50,000-99,999 15 respondents = .15 percent
  - .. Non-SMSA 159 respondents = 15.9 percent

- NUMBER OF TONS COLLECTED IN AN AVERAGE DAY
  - 1-6 tons 255 respondents = 25.5 percent
  - 7-12 tons 168 respondents = 16.8 percent
  - 13-24 tons 183 respondents = 18.3 percent
  - 25-49 tons 123 respondents = 12.3 percent
  - 50-99 tons 110 respondents = 11.0 percent
  - 100-249 tons 92 respondents = 9.2 percent
  - 250-499 tons 28 respondents = 2.8 percent
  - 500-999 tons 16 respondents = 1.6 percent
  - 1000 or more tons 11 respondents = 1.1 percent

(Note: 14 respondents or 1.4 percent would not answer this question)

- NUMBER OF TRUCKS
  - 1 truck 258 respondents = 25.8 percent
  - 2-3 trucks 317 respondents = 31.7 percent
  - 4-5 trucks 142 respondents = 14.2 percent
  - 6-9 trucks 127 respondents = 12.7 percent
  - 10-19 trucks 99 respondents = 9.9 percent
  - 20-49 trucks 41 respondents = 4.1 percent
  - 50 or more trucks 16 respondents = 1.6 percent
- NUMBER OF EMPLOYEES
  - 1 employee 191 respondents = 19.1 percent
  - 2-3 employees 275 respondents = 27.5 percent
  - 4-5 employees 128 respondents = 12.8 percent
  - 6-9 employees 146 respondents = 14.6 percent
  - 10-19 employees 109 respondents = 10.9 percent
  - 20-49 employees 83 respondents = 8.3 percent
  - 50 or more employees 38 respondents = 8.3 percent

(Note: 30 respondents or 3.0 percent did not answer this question)

- MIX OF COLLECTION

|  |  |  |  |  |
|---|---|---|---|---|
| .. | 100% Residential | 37 respondents | = | 3.7 percent |
| .. | 80-99% Residential | 183 respondents | = | 18.3 percent |
| .. | 60-79% Residential | 140 respondents | = | 14.0 percent |
| .. | 40-59% Residential | 108 respondents | = | 10.8 percent |
| .. | 20-39% Residential | 66 respondents | = | 6.6 percent |
| .. | 1-19% Residential | 52 respondents | = | 5.2 percent |
| .. | 100% Commercial or Industrial | 414 respondents | = | 41.4 percent |

Every question in the survey document was cross-tabulated by these variables and this provided significant insight into some of the causes for variations in methods of operation.

## DATA CONSIDERATIONS

The following chapters contain a detailed analysis of the survey responses in terms of the total sample and of various sub-populations. The purposes of this analysis are to provide a profile of the private sector and to describe the contribution of the private sector in collecting the nation's solid waste. To accomplish the latter objective, information about the private sector had to be compared with overall national statistics. Thus, for example, to estimate the proportion of the nation's single family residences served by the private sector, an estimate of the total number of single family housing units was needed. Such estimates were obtained through the gathering of secondary data from the following sources: Statistical Abstract of the United States, 1970, Bureau of the Census; General Housing Characteristics - United States Summary, 1970, Bureau of the Census; 1968 HUD Statistical Yearbook, U. S. Department of Housing and Urban Development; Country Business Patterns, 1969, U.S. Department of Commerce: United States Summary - U.S. Census of Population: 1970, Bureau of the Census; Housing Authorized by Building Permits and Public Contracts, 1970 Annual, U.S. Department of Housing and Urban Development.

These sources were then used to assess the private sector's contribution in the collection of various categories of customers. For example, in estimating the proportion of the nation's population served by the private sector, several steps were involved. First, since the Census data on housing characteristics are reported in terms of housing units, and the data for this study are given in terms of customers or housing structures, conversion factors between units and structures had to be established. For single family homes, this factor is one since the number of units equals the number of structures. For 2-4 unit apartment buildings, the number of structures was multiplied by three to arrive at a unit estimate. Finally, it was determined that the average number of units in buildings of 5 or more units is approxi-mately 12. Through the use of these conversion factors, the percentages of total customers and of total housing units collected by the private sector were computed. Furthermore, to determine the number and proportion of persons collected by the private sector, the number of housing units was multiplied by 3.1, which is the national average of population per housing unit.

There are, in addition, two issues which merit some discussion in this methodology section. First, part of the questionnaire deals with the disposal and recovery activities of the private sector of solid waste management. The intent of this survey was to interview solid waste collectors and to assess, of those who collect wastes, what their disposal and recovery activities involve. On the other hand, the survey design specifically excluded those in private industry who handle solely the disposal function or are only involved in salvage and recovery. There are a substantial number of private firms engaged in these fields, and their scope is not determined by this study. Thus, the data base on disposal and recovery in the following material is limited to those activities performed by collection contractors, and does not reflect the total private contribution.

The second issue again is related to the basic survey design and the definition of the universe to be sampled. The data obtained on the private sector's collection function, in terms of the amounts of wastes and the types of wastes, are also limited to those firms primarily engaged in the solid waste industry. Thus, specifically, excluded from the study are those firms which, as adjuncts to their primary businesses, haul their own waste products such as construction material, agricultural wastes, etc. and those companies or individuals who collect solid wastes on a "part-time" basis. The survey data, while reliably estimating the total residential, commercial, and industrial wastes collected by the full-time solid waste management industry, do not accurately reflect these other types of waste categories. Therefore, although the total wastes collected by the full-time private sector are estimated, as well as their shares of all residential, commercial, and industrial wastes, the total waste generated in the nation cannot be accurately estimated through the data in this study.

# 3

## VOLUME OF WASTE

The primary variables describing the private solid waste contractor are the quantity of waste which he collects and the types of customers from whom he collects. The subject of this chapter is, therefore, a description of the total wastes collected daily by the private sector. Tonnage collected is displayed by the major control variables appearing throughout this study (size of contractor, daily tonnage, mix of collection, SMSA size and region). Per capita waste disposal, along with tonnages generated by residential, commercial, and industrial sources are also examined.

This chapter is structured into the following subsections:

- Chapter Summary
- Total Volume
- Tonnage Per Contractor by Daily Tonnage Collected
- Daily Tonnage by Contractor Size
- Daily Tonnage by Mix of Collection
- Daily Tonnage by Region and City Size

## CHAPTER SUMMARY

The private sector collects over 685,000 tons per day of all types of wastes. Two-thirds of the refuse is commercial or industrial, 29 percent is residential and the balance is "miscellaneous" refuse such as demolition wastes. Based upon these tonnages, the per capita daily waste collected is 8.6 pounds of which 3.9 pounds is residential.

Commercial refuse is collected by the majority of contractors, and comprises the largest share of total tonnage. Industrial refuse, however, accounts for the most tons per customer.

The relationship of trucks and manpower to daily tonnage indicates an increased effectiveness in the tons per truck and the tons per employee as daily tonnage increases. This is a result of the concentration of commercial and industrial wastes among those collecting large tonnages. There is also a heavy concentration of total tonnage among the 1400 to 1500 contractors who collect over 100 tons per day. This concentration of the total tonnage collected per day among 15 percent of the contractors is also consistent with the concentration of truck ownership.

In terms of collection mix, contractors who collect a greater proportion of commercial and industrial tonnage collect the most tonnage per truck and man. The high ratios among these contractors seem due, in part, to the high usage of more automated and sophisticated collection equipment required in the collection of industrial and commercial wastes.

The contractors located in SMSA's of over one million account for over half of the tonnage collected. Most of the tonnage is concentrated in the Midwest, West, and North Atlantic, with residential tonnage more concentrated in the West, and industrial tonnage in the Midwest.

## TOTAL VOLUME

The total volume of refuse collected by the private sector is 685,466 tons per day (Table 3.1). Of this total, 199,132 tons or 21.9 percent is residential refuse; 230,865 tons or 33.7 percent is commercial refuse; 214,514 tons or 31.3 percent is industrial refuse; and the remaining 40,955 tons consist of miscellaneous refuse such as construction and demolition wastes.

TABLE 3.1

NATIONAL ESTIMATE - SHARE OF DAILY TONNAGE COLLECTED BY THE PRIVATE SECTOR BY RESIDENTIAL, COMMERCIAL, AND INDUSTRIAL REFUSE

| | Total Tons* | Residential | Commercial | Industrial |
|---|---|---|---|---|
| Number of Tons Collected By Private Sector On Average Day | 685,466 | 199,132 | 230,865 | 214,514 |
| Share of Total Tons | 100% | 21.9% | 33.7% | 31.3% |
| Number of Private Contractors Who Collect | 10,027 | 5,883 | 9,651 | 5,806 |
| Share of Total Contractors | 100% | 58.7% | 96.3% | 57.9% |

*Total tons includes demolition and construction refuse, and all other refuse.

In drawing conclusions from this data, the estimate of tonnage from miscellaneous refuse such as construction and demolition wastes should be considered a conservative projection. Those few organizations who dispose of their own wastes were not included in the sample.

Per capita collection by the private sector varies by the type of customer (Table 3.2). Industrial customers generate the largest number of pounds per day (1,196), dropping to 226 pounds per day for commercial customers (excluding apartments of five or more units), and 16 pounds per day for residential customers (single-family home, duplexes, and two to four-unit apartments). The average pounds per day for all customers is 50.

### TABLE 3.2

### NATIONAL ESTIMATE - DAILY TONNAGE PER CUSTOMER COLLECTED BY THE PRIVATE SECTOR BY RESIDENTIAL, COMMERCIAL, AND INDUSTRIAL REFUSE

| | Total Tons | Residential | Commercial | | Industrial |
|---|---|---|---|---|---|
| | | | Apartments-5 or More Units | Commercial-Excluding Apartments | |
| Number of Tons on Average Day | 685,466 | 199,132 | 45,872 | 184,993 | 214,514 |
| Number of Customers | 27,357,023 | 24,716,758 | 644,688 | 1,630,840 | 358,727 |
| Tons Per Customer | 0.025 | 0.008 | 0.071 | 0.113 | 0.598 |
| Pounds Per Customer | 50 | 16 | 142 | 226 | 1,196 |
| Number of Stops | 27,587,115 | 24,716,758 | 2,438,894 | | 431,463 |
| Tons Per Stop | 0.025 | 0.008 | 0.095 | | 0.497 |
| Pounds Per Stop | 50 | 16 | 190 | | 994 |

The amount of residential, commercial, and industrial refuse generated per day in the United States can be estimated based on the national estimate of total tonnage collected by the private sector (Table 3.3). Given the national total of residential, commercial, and industrial tons per day (and excluding miscellaneous waste), a daily per capita generation of each type of refuse can

### TABLE 3.3

### NATIONAL ESTIMATE - PER CAPITA GENERATION OF RESIDENTIAL, COMMERCIAL, AND INDUSTRIAL REFUSE

| | Total* | Residential | Commercial | Industrial |
|---|---|---|---|---|
| Residential, Commercial, and Industrial Tons Collected by Private Sector on Average Day | 644,511 | 199,132 | 230,865 | 214,514 |
| Share of Residential, Commercial, and Industrial Customers Collected Nationally | 52.4% | 50.2% | 91.0% | 94.0% |
| Residential, Commercial, and Industrial Tons Collected Nationally on Average Day | 878,581 | 396,677 | 253,698 | 228,206 |
| Percent of Total Tonnage | 73.3% | 50.2% | 91.0% | 94.0% |
| National 1970** Population | 203,211,026 | | | |
| Refuse per Person Per Day | 8.6 | 3.9 | 2.5 | 2.2 |

* Total does not include demolition and construction refuse, or other refuse.
** From 1970 Census

be calculated by dividing the total United States population into the number of tons. This yields a per capita figure of 3.9 pounds of residential refuse, 2.5 pounds of commercial refuse, and 2.2 pounds of industrial refuse, or 8.6 pounds of residential, commercial, and industrial waste per person per day.

The private sector collects 52.4 percent of the total customers and 73.3 percent of the total tonnage. The disproportionate share is due to the high proportions of commercial and industrial collection and the high volumes experienced there.

## TONNAGE PER CONTRACTOR BY DAILY TONNAGE COLLECTED

The average contractor collects 68 tons per day. This results in ratios of 14 tons per truck and 9 tons per man. These ratios vary widely on the basis of the total daily tonnage the company collects. For example, those companies with daily collection ranging from 1-6 tons in fact average 3.5 tons per company, 2.9 tons per truck, and only 2.3 tons per man. These relatively low rates are due to the large residential component (41.7%) in the tonnage collected by this portion of the population (Table 3.5) and to an equipment mix which is more oriented toward the open truck (Table 5.20).

Gross tonnage collected is, of course, a primary variable in describing the contractor. Neither number of customers nor number of trucks enable the analyst to illustrate the full scope of a company's contribution. Customer count is not adequate because a residential customer cannot be equated with a commercial or industrial customer. As we have indicated, a typical residential customer generates 16 pounds per day while an industrial customer generates an average of 1196 pounds per day. Thus, in terms of tonnage, the average industrial customer is the equivalent of 75 residential customers. Therefore, a simple customer count does not fully describe a contractor's position in the industry. Truck counts also misrepresent the actual description of a contractor due to differences in equipment capacities and material handling techniques. So, tonnage collected is the most generally accurate variable.

Those contractors who are largest in terms of customer and truck count, also collect the largest daily tonnage. Specifically, 14.7 percent of the contractors collect 100 or more tons per day. The profile of these contractors reveals a lower percentage of both residential and commercial tonnage than that found among smaller contractors; however, the larger contractors handle a significantly greater proportion of industrial waste. The percentage of industrial waste collected is the most significant factor in these contractors' overall share of market which includes 74.7 percent of all wastes collected by the private sector. Evidence suggests these contractors

## TABLE 3.4

## NATIONAL ESTIMATE OF TONNAGE BY NUMBER OF TONS PER DAY IN THE PRIVATE SECTOR

| Type of Tonnage | Number of Tons Collected Per Day | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1-6 | 7-12 | 13-24 | 25-49 | 50-99 | 100-249 | 250-499 | 500-999 | 1000 or more | Total |
| Total Contractors | 2,636 | 1,726 | 1,865 | 1,238 | 1,099 | 918 | 277 | 161 | 110 | 10,027 |
| Total Tonnage* | 8,911 | 15,766 | 31,531 | 43,184 | 74,030 | 139,150 | 94,594 | 104,191 | 174,108 | 685,466 |
| Residential | 3,584 | 5,177 | 11,749 | 16,329 | 26,086 | 37,437 | 26,883 | 33,653 | 38,233 | 199,132 |
| Commercial | 3,463 | 6,926 | 12,928 | 15,237 | 25,626 | 48,482 | 32,090 | 39,709 | 46,173 | 230,865 |
| Industrial | 1,073 | 2,789 | 5,792 | 9,653 | 18,877 | 45,906 | 31,319 | 27,029 | 72,291 | 214,514 |

*Total Tonnage includes demolition and construction refuse, and all other refuse.

## TABLE 3.5

## PERCENT DISTRIBUTION OF TONNAGE BY NUMBER OF TONS PER DAY IN THE PRIVATE SECTOR

| Type of Tonnage | Number of Tons Collected Per Day | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1-6 | 7-12 | 13-24 | 25-49 | 50-99 | 100-249 | 250-499 | 500-999 | 1000 or more | Total |
| Distribution of Total Contractors | 26.3% | 17.2% | 18.6% | 12.3% | 11.0% | 9.2% | 2.8% | 1.6% | 1.1% | 100% |
| Distribution of Tonnage Among Number of Tons | | | | | | | | | | |
| Total Tonnage | 1.3 | 2.3 | 4.6 | 6.3 | 10.8 | 20.3 | 13.8 | 15.2 | 25.4 | 100 |
| Residential | 1.8 | 2.6 | 5.9 | 8.2 | 13.1 | 18.8 | 13.5 | 16.9 | 19.2 | 100 |
| Commercial | 1.5 | 3.0 | 5.6 | 6.6 | 11.1 | 21.0 | 13.9 | 17.2 | 20.0 | 100 |
| Industrial | 0.5 | 1.3 | 2.7 | 4.5 | 8.8 | 21.4 | 14.6 | 12.6 | 33.7 | 100 |
| Distribution of Tonnage Within Number of Tons | | | | | | | | | | |
| Total Tonnage | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| Residential | 41.7 | 33.6 | 38.5 | 39.2 | 36.4 | 27.8 | 29.4 | 33.6 | 22.7 | 29.1 |
| Commercial | 40.3 | 45.2 | 41.5 | 36.1 | 35.2 | 35.4 | 34.4 | 38.8 | 27.0 | 33.7 |
| Industrial | 11.7 | 17.5 | 18.1 | 22.0 | 25.0 | 32.3 | 32.5 | 25.4 | 40.9 | 31.3 |
| Other* | 6.3 | 3.7 | 1.9 | 2.7 | 3.4 | 4.5 | 3.7 | 2.2 | 9.4 | 5.9 |

* Other Refuse includes demolition and construction refuse, and all other refuse.

TABLE 3.6

TONS PER TRUCK AND EMPLOYEE BY TONS COLLECTED PER DAY
IN THE PRIVATE SECTOR

| | Number of Tons Collected Per Day | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1-6 | 7-12 | 13-24 | 25-49 | 50-99 | 100-249 | 250-499 | 500-999 | 1000 or more | Total |
| Total Contractors | 2,636 | 1,726 | 1,865 | 1,238 | 1,099 | 918 | 277 | 161 | 110 | 10,027 |
| Mean Number of Tons Per Day | 3.5 | 9.7 | 17.8 | 36.1 | 69.7 | 156.6 | 349.7 | 672.6 | 1635.6 | 68.4 |
| Mean Number Trucks Collecting Per Day | 1.2 | 1.5 | 2.6 | 3.7 | 7.0 | 11.0 | 19.7 | 32.9 | 48.9 | 4.8 |
| Mean Number Employees Collecting Per Day | 1.5 | 2.2 | 4.0 | 5.8 | 9.3 | 17.6 | 31.3 | 59.3 | 105.7 | 7.5 |
| Number of Tons Per Truck | 2.9 | 6.5 | 6.8 | 9.3 | 10.0 | 14.2 | 17.7 | 20.4 | 33.4 | 14.3 |
| Number of Tons Per Man | 2.3 | 4.4 | 4.5 | 6.2 | 7.5 | 8.9 | 11.2 | 11.3 | 15.5 | 9.1 |
| *Mean Crew Size Per Truck | 1.4 | 1.5 | 1.6 | 1.6 | 1.5 | 1.6 | 1.5 | 1.9 | 1.6 | 1.6 |
| Mean Capacity in Cubic Yards of Compactor and Non Packer Trucks | 15.1 | 21.1 | 19.5 | 20.7 | 21.9 | 22.8 | 22.9 | 25.3 | 23.9 | 21.48 |

* Mean Crew Size reported for all types of trucks.

specialize in the larger tonnage producing customers in each category. These contractors collect 75 percent of the total tonnage, with 51 percent of the total trucks (Table 5.21) and serve 62 percent of the total customers (Table 4.10). Operationally, these contractors are capable of this daily volume because of stationary compaction, roll-off, and hoist type vehicles. Packer trucks comprise a large percent of their total fleet (over two-thirds) and they operate 78.5 percent of the total roll-off vehicles and 67.7 percent of the hoist type vehicles.

In addition, large contractors are more apt to service customers under a government franchise than are small contractors (Table 6.8), and the efficiency of a consolidated route adds to the potential number of tons per truck which can be collected on an average day.

The distribution of tonnage by the number of tons collected per day (Table 3.5) illustrates the concentration of total tonnage among the 1,466 contractors collecting over 100 tons per day. Of the total daily tonnage, these contractors collect 512,043 of 685,466 tons, or three-fourths of the total tonnage. The contractors collecting over 100 tons per day collect an even larger share of the industrial tonnage (82%), and contractors collecting 1000 tons or more per day collect 33.7 percent of the industrial tonnage alone.

In general, the larger the contractor, the larger the proportion of industrial waste collected. Industrial refuse makes up the largest percent of total tons for contractors collecting over 1000 tons per day (40.9%), and the lowest percent (11.7%) for contractors collecting 1-6 tons per day.

## DAILY TONNAGE BY CONTRACTOR SIZE

The distribution of tonnage by contractor size (Table 3.8) indicates that approximately two-thirds of the residential, commercial, and industrial refuse is concentrated among the contractors with 10 or more trucks who account for 15 percent of the total contractors. Residential refuse is concentrated most heavily among the 157 contractors operating 50 or more trucks who collect 29 percent or57, 350 tons of the total 199, 132 residential tonnage collected daily. Industrial refuse is concentrated among contractors with 10-49 trucks. These contractors collect 63 percent of the total industrial tonnage, or 134, 286 tons per day.

Generally, as contractor size increases, the share of residential and commercial tonnage decreases, while the share of industrial tonnage increases. Contractors with 50 or more trucks are an exception, collecting a different configuration of refuse than any other contractor size. For all other contractor sizes, commercial and industrial tonnage account for the largest share of total tonnage, but for contractors with 50 or more trucks, residential refuse comprises over half of their total tonnage (Figure 3. 1).

### TABLE 3.7

### NATIONAL ESTIMATE OF TONNAGE BY CONTRACTOR SIZE IN THE PRIVATE SECTOR

| Type of Tonnage | Size of Contractor | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 truck | 2-3 trucks | 4-5 trucks | 6-9 trucks | 10-19 trucks | 20-49 trucks | 50 or more trucks | Total |
| Total Contractors | 2,608 | 3,193 | 1,421 | 1,261 | 982 | 405 | 157 | 10,027 |
| Total Tonnage* | 14,395 | 54,837 | 47,983 | 101,449 | 180,963 | 172,737 | 113,102 | 685,466 |
| Residential | 4,779 | 15,931 | 12,346 | 23,896 | 45,203 | 39,428 | 57,350 | 199,132 |
| Commercial | 5,772 | 21,932 | 18,238 | 37,400 | 59,101 | 58,178 | 30,012 | 230,865 |
| Industrial | 2,789 | 14,801 | 13,514 | 36,253 | 69,074 | 65,212 | 13,085 | 214,514 |

*Total Tonnage includes demolition and construction refuse, and all other refuse.

## TABLE 3.8

## PERCENT DISTRIBUTION OF TONNAGE BY CONTRACTOR SIZE IN THE PRIVATE SECTOR

| Type of Tonnage | Size of Contractor | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 truck | 2-3 trucks | 4-5 trucks | 6-9 trucks | 10-19 trucks | 20-49 trucks | 50 or more trucks | Total |
| Distribution of Total Contractors | 26.0% | 31.8% | 14.1% | 12.6% | 9.8% | 4.0% | 1.6% | 100% |
| Distribution of Tonnage Among Contractor Sizes | | | | | | | | |
| Total Tonnage | 2.1 | 8.0 | 7.0 | 14.8 | 26.4 | 25.2 | 16.5 | 100 |
| Residential | 2.4 | 8.0 | 6.2 | 12.0 | 22.7 | 19.8 | 28.8 | 100 |
| Commercial | 2.5 | 9.5 | 7.9 | 16.2 | 25.6 | 25.2 | 13.0 | 100 |
| Industrial | 1.3 | 6.9 | 6.3 | 16.9 | 32.2 | 30.4 | 6.1 | 100 |
| Distribution of Tonnage Within Contractor Size | | | | | | | | |
| Total | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| Residential | 34.2 | 30.0 | 27.0 | 24.5 | 25.8 | 23.6 | 52.5 | 29.1 |
| Commercial | 40.5 | 41.0 | 39.0 | 37.6 | 33.2 | 34.2 | 27.0 | 33.7 |
| Industrial | 18.4 | 26.6 | 28.0 | 35.3 | 37.5 | 37.0 | 11.3 | 31.3 |
| Other* | 6.9 | 2.4 | 6.0 | 2.6 | 3.5 | 5.2 | 9.2 | 5.9 |

*Other Refuse includes demolition and construction refuse, and all other refuse.

## TABLE 3.9

## TONS PER TRUCK AND EMPLOYEE BY SIZE OF CONTRACTOR IN THE PRIVATE SECTOR

| | Size of Contractor | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 truck | 2-3 trucks | 4-5 trucks | 6-9 trucks | 10-19 trucks | 20-49 trucks | 50 or more trucks | Total |
| Total Contractors | 2,608 | 3,193 | 1,421 | 1,261 | 982 | 405 | 157 | 10,027 |
| Mean Number of Tons Per Day | 6.1 | 17.9 | 34.7 | 82.4 | 191.1 | 435.9 | 779.2 | 68.4 |
| Mean Number Trucks Collecting Per Day | 0.9 | 1.6 | 3.0 | 5.2 | 10.3 | 22.5 | 69.5 | 4.8 |
| Mean Number Employees Collecting Per Day | 1.3 | 2.4 | 4.5 | 8.0 | 16.3 | 35.9 | 124.6 | 7.5 |
| Number of Tons Per Truck | 6.7 | 11.0 | 11.7 | 16.0 | 18.3 | 19.4 | 11.2 | 14.3 |
| Number of Tons Per Man | 4.7 | 7.5 | 7.7 | 10.3 | 11.7 | 12.1 | 6.3 | 9.1 |
| *Mean Crew Size Per Truck | 1.5 | 1.6 | 1.5 | 1.5 | 1.6 | 1.5 | 1.8 | 1.6 |
| Mean Capacity in Cubic Yards of Compactor and Non Packer Trucks | 17.3 | 19.2 | 20.1 | 21.3 | 22.9 | 23.7 | 23.2 | 21.5 |

* Mean Crew Size reported for all types of trucks

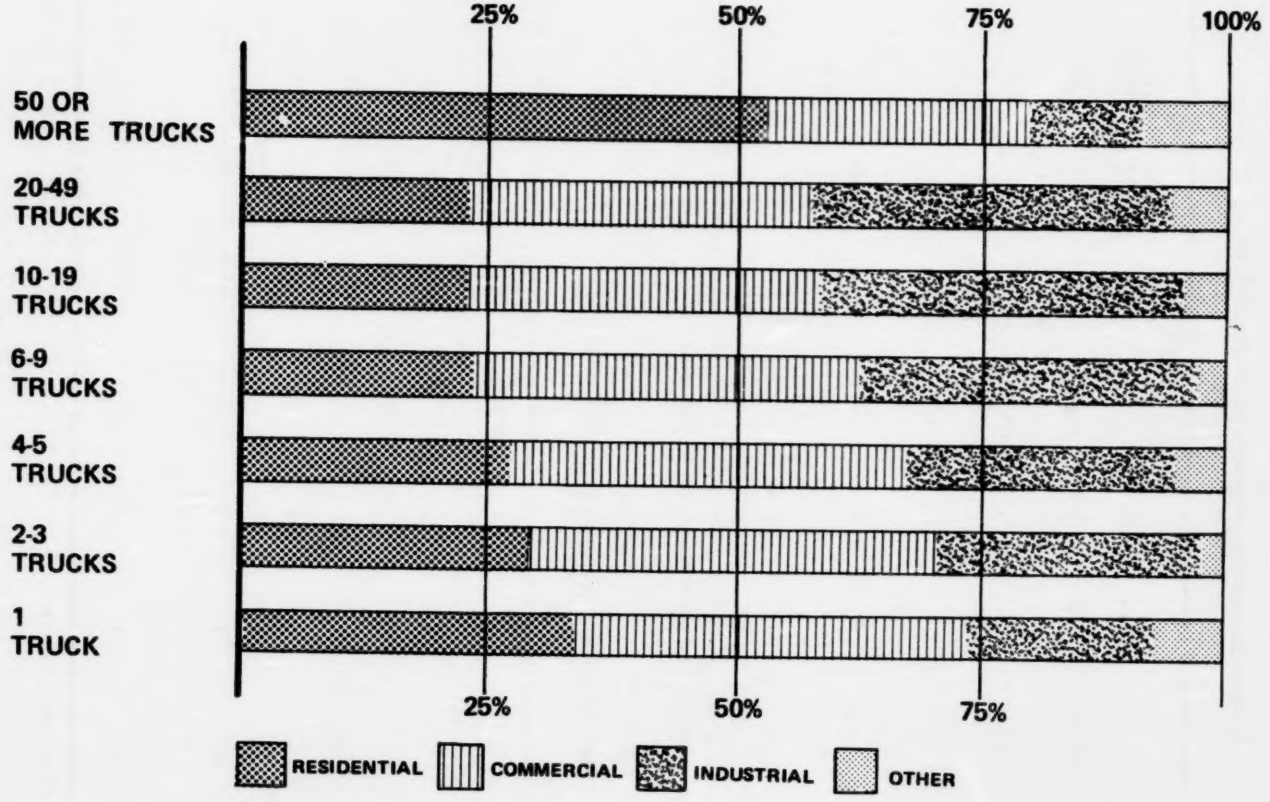


FIGURE 3.1: DISTRIBUTION OF MIX OF TONNAGE COLLECTED WITHIN CONTRACTOR SIZE CATEGORIES

## DAILY TONNAGE BY MIX OF COLLECTION

Those contractors whose collection mix is 20 to 39 percent residential tonnage are, on the average, the largest contractors, as measured by mean number of trucks, employees, and tons collected. In terms of efficiency, however, the contractors with a heavy commercial mix collect more tons per truck and more tons per employee than those with a heavy residential mix. This results from a high level of containerization and mechanization. The ratio of tons per employee is highest among contractors who collect 100 percent commercial and industrial refuse (14.8 tons per employee).

The high ratio of tons per employee among contractors collecting 100 percent commercial and industrial is due to the types of trucks they use. These contractors on the average use more front loader packers, and special collection vehicles such as roll-off chassis, and these pieces of equipment usually require a smaller crew size per truck. As shown in Table 3.10, mean crew size is smallest among contractors collecting 100 percent commercial and industrial, yet their packer and non-packer trucks have the largest capacity.

TABLE 3.10

TONS PER TRUCK AND EMPLOYEE BY MIX OF COLLECTION IN THE PRIVATE SECTOR

| | | | % Residential Collection | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 100% | 80-99% | 60-79% | 40-59% | 20-39% | 1-19% | 100% | Total |
| Total Contractors | 375 | 1,835 | 1,402 | 1,081 | 661 | 552 | 4,143 | 10,027 |
| Mean Number of Tons Per Day | 29.3 | 44.4 | 67.8 | 88.9 | 168.9 | 45.8 | 72.4 | 68.4 |
| Mean Number of Trucks Collecting Per Day | 2.7 | 4.9 | 5.9 | 6.4 | 8.6 | 3.3 | 4.0 | 4.8 |
| Mean Number of Employees Collecting Per Day | 5.6 | 9.7 | 11.4 | 10.6 | 14.7 | 4.3 | 4.7 | 7.5 |
| Mean Number of Tons Per Truck | 10.9 | 9.1 | 11.5 | 13.9 | 19.6 | 13.9 | 18.1 | 14.3 |
| Mean Number of Tons Per Employee | 5.2 | 4.6 | 5.9 | 8.4 | 11.5 | 10.7 | 15.4 | 9.1 |
| Mean Crew Size Per Truck** | 2.1 | 2.0 | 1.9 | 1.6 | 1.7 | 1.3 | 1.2 | 1.6 |
| Mean Capacity in Cubic Yards of Compactors and Non Packers | 18.8 | 20.3 | 20.8 | 22.7 | 22.3 | 21.6 | 23.4 | 21.4 |

*Commercial and Industrial
**Mean crew size reported for all types of trucks.

Contractors collecting 80 to 99 percent residential refuse have the lowest ratio of tons per truck and per man, even though they have more trucks and employees than contractors collecting 100 percent residential. This indicates that when a contractor collects over 80 percent of his tonnage from one category, the diversion of a small portion of the collection effort to another type of refuse leads to a less efficient utilization of equipment than a full commitment to either residential, or commercial and industrial collection.

TABLE 3.11

NATIONAL ESTIMATE OF TONNAGE BY MIX OF COLLECTION
IN THE PRIVATE SECTOR

| Type of Tonnage | % Residential Collection | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 100% | 80-99% | 60-79% | 40-59% | 20-39% | 1-19% | 100%* | Total |
| Total Contractors | 375 | 1,835 | 1,402 | 1,081 | 661 | 522 | 4,143 | 10,027 |
| Total Tonnage** | 9,597 | 78,143 | 91,852 | 91,852 | 106,247 | 22,620 | 285,154 | 685,466 |
| Residential | 9,359 | 60,536 | 57,947 | 41,220 | 28,277 | 1,991 | -- | 199,132 |
| Commercial | -- | 6,695 | 22,394 | 24,703 | 39,709 | 12,005 | 125,129 | 230,865 |
| Industrial | -- | 2,789 | 6,006 | 13,729 | 35,180 | 7,508 | 149,087 | 214,514 |

*Commercial and Industrial
**Total Tonnage includes demolition and construction refuse, and all other refuse.

The percent distribution of tonnage by mix of collection categories (Table 3.12) illustrates that the 4,143 contractors who collect 100 percent commercial and industrial waste pick up over half of the total commercial refuse (125,129 tons) and more than two-thirds of the industrial refuse (149,087). The heaviest concentration of residential refuse is among the contractors whose mix of collection is 40-99 percent residential. These contractors collect only 38.2 percent of the total tonnage, but 80.2 percent of the residential refuse. Contractors with this mix of collection play a major role in residential franchising (Table 6.13), and as a result, serve approximately 18.7 million (68.5%) of the single family houses served by the private sector.

## TABLE 3.12

### PERCENT DISTRIBUTION OF TONNAGE BY MIX OF COLLECTION IN THE PRIVATE SECTOR

| Type of Tonnage | % Residential Collection | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 100% | 80-99% | 60-79% | 40-59% | 20-39% | 1-19% | 100%* | Total |
| Distribution of Total Contractors | 3.7% | 18.3% | 14.0% | 10.8% | 6.6% | 5.2% | 41.3% | 100% |
| Distribution of Tonnage Among Mix of Collection | | | | | | | | |
| Total Tonnage | 1.4 | 11.4 | 13.4 | 13.4 | 15.5 | 3.3 | 41.6 | 100 |
| Residential | 4.7 | 30.4 | 29.1 | 20.7 | 14.2 | 1.0 | 0 | 100 |
| Commercial | -- | 2.9 | 9.7 | 10.7 | 17.2 | 5.2 | 54.2 | 100 |
| Industrial | -- | 1.3 | 2.8 | 6.4 | 16.4 | 3.5 | 69.5 | 100 |
| Distribution of Tonnage Within Mix of Collection | | | | | | | | |
| Total | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| Residential | 99.6 | 80.1 | 65.2 | 46.4 | 27.5 | 9.4 | 0 | 29.1 |
| Commercial | -- | 8.7 | 24.8 | 27.4 | 38.1 | 54.5 | 44.6 | 33.7 |
| Industrial | -- | 3.6 | 6.5 | 14.7 | 32.6 | 33.1 | 51.4 | 31.3 |
| Other** | 0.4 | 7.6 | 3.5 | 11.5 | 1.8 | 3.0 | 4.0 | 5.9 |

*Commercial and Industrial

**Other Refuse includes demolition and construction refuse, and all other refuse.

## DAILY TONNAGE BY REGION AND CITY SIZE

Table 3.14 shows that contractors located in the Midwest collect 28.5 percent, (195,358 tons), of the total national tonnage, followed by the West (23.7%) and the North Atlantic (19.9%). These shares of tonnage tend to reflect the high population densities and heavy industrialization (especially in the Midwest) found in these regions.

In the category of residential tonnage, the West is predominant, where 75,272 tons out of the 199,132 total residential tons (37.8%) are collected by the private sector. This is directly related to the relatively high proportion of franchising in the Western region.

Total tonnage is heavily concentracted among contractors located in SMSA's of over one million. These contractors comprise 44.5 percent of the private sector and collect 64 percent of the total tonnage (438,698 tons). Contractors in SMSA's of 500,000 - 1,000,000 collect a large share of industrial tons (22.0%) compared to their share of total tons (16.0%). Residential refuse comprises a significantly higher percent of total tonnage (37%) for contractors located in non-SMSA's, than for the contractors in SMSA's.

TABLE 3.13

NATIONAL ESTIMATE OF TONNAGE BY REGION IN THE PRIVATE SECTOR

| Type of Tonnage | Region | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | North-east | North Atlantic | Mid-Atlantic | South Atlantic | Mid-West | North Central | South Central | Mountain | West | Total |
| Total Contractors | 529 | 2,024 | 644 | 373 | 2,401 | 1,603 | 507 | 391 | 1,555 | 10,027 |
| Total Tonnage* | 43,867 | 136,073 | 25,562 | 29,220 | 195,358 | 32,820 | 51,209 | 9,053 | 162,373 | 685,466 |
| Residential | 4,613 | 29,095 | 13,289 | 9,662 | 43,141 | 13,533 | 8,374 | 2,097 | 75,329 | 199,132 |
| Commercial | 15,621 | 52,793 | 8,206 | 12,033 | 52,731 | 10,037 | 28,676 | 3,927 | 46,841 | 230,865 |
| Industrial | 21,143 | 46,571 | 3,431 | 7,348 | 39,217 | 8,060 | 10,882 | 2,912 | 24,946 | 214,514 |

*Total Tonnage includes demolition and construction refuse, and all other refuse.

## TABLE 3.14

## PERCENT DISTRIBUTION OF TONNAGE BY REGION IN PRIVATE SECTOR

| Type of Tonnage | Region<br>North-east | North Atlantic | Mid-Atlantic | South Atlantic | Mid-West | North Central | South Central | Mountain | West | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| Distribution of Total Contractors | 5.3% | 20.2% | 6.4% | 3.7% | 23.9% | 16.0% | 5.1% | 3.9% | 15.5% | 100% |
| Distribution of Tonnage Among Regions | | | | | | | | | | |
| Total Tonnage | 6.4 | 19.9 | 3.7 | 4.3 | 28.5 | 4.8 | 7.5 | 1.3 | 23.7 | 100 |
| Residential | 2.3 | 14.6 | 6.7 | 4.9 | 21.7 | 6.8 | 4.2 | 1.1 | 37.8 | 100 |
| Commercial | 6.8 | 22.9 | 3.6 | 5.2 | 22.8 | 4.3 | 12.4 | 1.7 | 20.3 | 100 |
| Distribution of Tonnage Within Regions | | | | | | | | | | |
| Total Tonnage | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| Residential | 10.5 | 21.4 | 52.0 | 33.1 | 22.1 | 41.2 | 16.4 | 23.2 | 46.4 | 29.1 |
| Commercial | 35.6 | 38.8 | 32.1 | 41.2 | 27.0 | 30.6 | 56.0 | 43.4 | 28.8 | 33.7 |
| Industrial | 48.2 | 34.2 | 13.4 | 25.1 | 45.7 | 24.6 | 21.3 | 32.2 | 15.4 | 31.3 |
| Other* | 5.7 | 5.6 | 2.5 | 0.6 | 5.2 | 3.6 | 6.3 | 1.1 | 9.4 | 5.9 |

*Other Refuse includes demolition and construction refuse, and all other refuse.

## TABLE 3.15

## NATIONAL ESTIMATE OF TONNAGE BY SMSA SIZE IN PRIVATE SECTOR

| Type of Tonnage | SMSA Size<br>Over 1,000,000 | 500,000-1,000,000 | 250,000-499,999 | 100,000-249,999 | 50,000-999,999 | Non-SMSA | Total |
|---|---|---|---|---|---|---|---|
| Total Contractors | 4,456 | 1,311 | 1,498 | 1,017 | 149 | 1,596 | 10,027 |
| Total Tonnage* | 438,698 | 111,731 | 53,466 | 35,644 | 6,855 | 39,072 | 685,466 |
| Residential | 135,011 | 21,307 | 15,333 | 11,351 | 2,190 | 13,939 | 199,132 |
| Commercial | 145,907 | 39,016 | 19,162 | 12,467 | 1,847 | 12,236 | 230,865 |
| Industrial | 125,920 | 47,408 | 17,161 | 10,511 | 2,789 | 10,726 | 214,514 |

*Total Tonnage includes demolition and construction refuse, and all other refuse.

## TABLE 3.16

## PERCENT DISTRIBUTION OF TONNAGE BY SMSA SIZE IN PRIVATE SECTOR

| Type of Tonnage | SMSA Size | | | | | | |
|---|---|---|---|---|---|---|---|
| | Over 1,000,000 | 500,000-1,000,000 | 250,000-499,999 | 100,000-249,999 | 50,000-99,999 | Non-SMSA | Total |
| Distribution of Total Contractors | 44.5% | 13.1% | 14.9% | 10.1% | 1.5% | 15.9% | 100% |
| Distribution of Total Tonnage Among SMSA Sizes | | | | | | | |
| Total Tonnage | 64.0 | 16.3 | 7.8 | 5.2 | 1.0 | 5.7 | 100 |
| Residential | 67.8 | 10.7 | 7.7 | 5.7 | 1.1 | 7.0 | 100 |
| Commercial | 63.2 | 16.9 | 8.3 | 5.4 | 0.8 | 5.3 | 100 |
| Industrial | 58.7 | 22.1 | 8.0 | 4.9 | 1.3 | 5.0 | 100 |
| Distribution of Tonnage Within SMSA Size | | | | | | | |
| Total | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| Residential | 31.8 | 19.8 | 29.7 | 33.3 | 31.1 | 37.0 | 29.1 |
| Commercial | 33.8 | 35.6 | 36.5 | 36.0 | 27.2 | 31.8 | 33.7 |
| Industrial | 28.2 | 41.8 | 31.6 | 29.0 | 39.9 | 27.1 | 31.3 |
| Other* | 6.2 | 2.8 | 2.2 | 1.7 | 1.8 | 4.1 | 5.9 |

*Other Refuse includes demolition and construction refuse, and all other refuse.

# 4

# CUSTOMERS OF THE PRIVATE SECTOR

The contribution of the private sector is discussed in this chapter in terms of the estimate of the number of customers served, the percentage these customers represent of the total population, the types of wastes collected, and the frequency with which waste is collected. Using the survey data base, forecasts are made of the total number of customers, stops, housing units, and people served.

To maintain consistency with other sections of this report, these data are presented in terms of the five major analysis variables:

- contractor size
- daily tonnage
- mix of collection
- SMSA size
- Region

Frequency of collection and incidence of curb service are presented and analyzed by the above mentioned variables, and the types of wastes collected by the private sector are analyzed by contractor size and daily tonnage.

This chapter is structured into the following subsections:

- Chapter Summary
- Estimates of Private Sector Market
- Customers by Contractor Size
- Customers and Tonnage Shares
- Customers by Daily Tonnage
- Customers by Mix of Collection
- Customers by Regional and City Size Characteristics
- Type of Waste Collected and Frequency
- Curb Service

## CHAPTER SUMMARY

The private sector collects approximately half of the residential customers in the United States, and over 90 percent of the commercial and industrial customers. While residential customers account for 90 percent of the customers serviced by all contractors, their wastes comprise only 21 percent of the total tonnage collected. Furthermore, except for the largest contractors, the proportion of residential customers to total customers increases as contractor size increases.

As with truck ownership, large contractors collect a disproportionately large share of customers in relation to their percentage of total contractors: 15 percent of the contractors service 69 percent of the total customers collected by the private sector. Contractors located in SMSA's of over one million also collect a large share (over half) of total customers.

Apartments of 5 or more units are predominantly collected twice a week or more, while single family houses are usually collected once a week.

The types of wastes collected by private contractors vary by contractor size. As contractor size increases, the types of wastes collected become more comprehensive. This coincides with the use of more sophisticated and specialized equipment by the large contractors.

Slightly over half of the residential customers serviced by the private sector receive curb service. Curb service tends to be associated with large contractors located in SMSA's of over one million.

## ESTIMATES OF PRIVATE SECTOR MARKET

Private contractors serve over 108 million people each week in the collection of all types of residential wastes throughout the nation. This represents more than 49 million housing units or over 55 percent of the total. Commercial and industrial waste collection are predominantly a function of private contractor collection. Over 90 percent of all commercial and industrial establishments are serviced by private contractors.

Customers are divided into residential (including single family and 2 to 4 unit apartments), commercial (apartments of 5 or more units, stores, offices, etc.), and industrial categories. Thus, commercial tonnage, in terms of the types of wastes, may be somewhat distorted due to the inclusion of apartment waste in the total estimate.

TABLE 4.1

NATIONAL ESTIMATE - PRIVATE SECTOR'S SHARE OF CUSTOMERS

| | Residential | Single Family Homes | Duplexes-4 Units | Commercial* | Apts. 5 or More Units | Industrial |
|---|---|---|---|---|---|---|
| Number of Private Contractors Who Collect | 5,883 | 5,883 | 4,284 | 9,651 | 6,260 | 5,806 |
| Percent of All Private Contractors (10,027) | 59% | 59% | 43% | 96% | 62% | 58% |
| Number of Customers Collected by Private Sector | 24,716,758 | 23,348,933 | 1,367,825 | 2,275,528 | 644,688 | 358,727 |
| Number of Stops Collected by Private Sector | | | | 2,438,894 | | 431,463 |
| Estimated Number of Customers Nationally | 49,191,438 | 46,075,691 | 3,115,747 | 2,500,580 | 678,612 | 458,206 |
| Percent of Total Customers Collected by Private Sector | 50% | 51% | 44% | 91% | 95% | 94% |

*Commercial Customers Include Apartments of Five or More Units.

Table 4.1 specifically identifies the number and percent of apartment units served. The residential and apartment market shares of 50 percent and 95 percent, respectively, indicate that the balance of the universe is served either by a municipal operation (e.g., Los Angeles, Miami, etc.), by the organization generating the waste, or by no collection operation at all.

A large portion of the contractors collect only commercial and industrial wastes, and a small proportion handle only residential customers. Of course, the majority of contractors serve all types of customers.

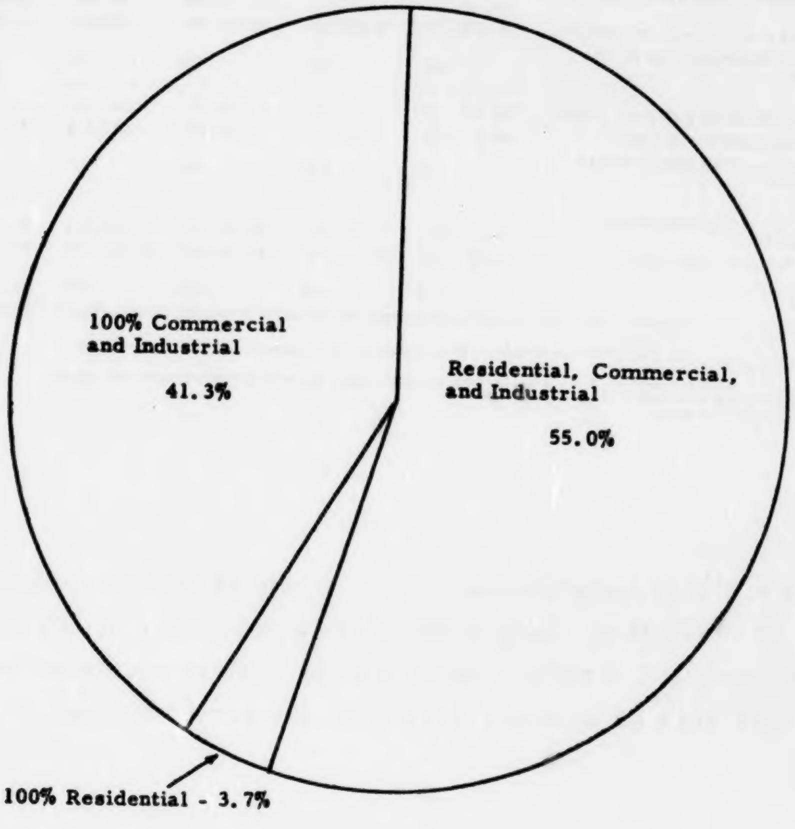


FIGURE 4.1: DISTRIBUTION OF CONTRACTORS AMONG CUSTOMER TYPES

### TABLE 4.2

### NATIONAL ESTIMATE - SHARE OF POPULATION SERVED BY PRIVATE SECTOR

| | Single Family Homes | Duplexes-4 Units | Total Residential | Apts. 5 or More Units | Total ** Housing Units |
|---|---|---|---|---|---|
| Number of Private Contractors Who Collect | 5,883 | 4,284 | 5,883 | 6,260 | --*** |
| Percent of All Private Contractors (10,027) | 59% | 43% | 59% | 62% | -- |
| Number of Customers Collected By Private Sector | 23,348,933 | 1,367,825 | 24,716,758 | 644,688 | 25,361,466 |
| Estimated Number of Customers Nationally | 46,075,691 | 3,115,747 | 49,191,438 | 678,612 | 49,870,050 |
| Percent of Total Customers Collected By Private Sector | 51% | 44% | 50% | 95% | 51% |
| Number of Units Collected By Private Sector | 23,348,933 | 4,103,475 | 27,452,408 | 7,645,282 | 35,097,690 |
| Number of occupied Units Nationally * | 46,075,691 | 9,347,242 | 55,422,933 | 8,026,814 | 63,449,747**** |
| Percent of Total occupied Units Collected By Private Sector | 51% | 44% | 50% | 95% | 55% |
| Population Collected By Private Sector (3.1 per occupied unit) | 72,381,692 | 12,720,773 | 85,102,465 | 23,700,374 | 108,802,839 |
| Population in Occupied Housing Units | 142,834,642 | 28,976,450 | 171,811,092 | 24,883,128 | 197,399,913**** |
| Percent of Population Collected By Private Sector | 51% | 44% | 50% | 95% | 55% |

* Includes mobile homes and trailers

** Total Housing Units include Residential Units (Single Family Homes and Duplexes to 4 Unit Apartments), and Apartments of five or more.

*** The Number of contractors serving Total Housing Units is unobtainable due to overlap between contractors collecting Residential Units and Apartments.

**** From 1970 Census of Housing.

Table 4.2 bears explanation only in terms of the total number of people reported. The 1970 U.S. Census estimates a population of 203 million people. Our table reports 197.4 million and the difference is accounted for by those in group quarters such as prisons, hospitals, the armed forces, etc.

## CUSTOMERS BY CONTRACTOR SIZE

The private contractor collects an average of 2,700 customers (Table 4.4). However, a more revealing portrayal of the industry indicates that the small proportion of large contractors (15.4%) collect the bulk of the customers (68.8%) (Table 4.5). The largest contractors in terms of truck count serve an average of 38,000 customers, or about 14 times the norm. Furthermore, it is important to note that the customer proportion (68.8%) served by those contractors operating 10 or more trucks is significantly greater than the truck proportion (59.5%) that they operate. This indicates a high level of efficiency in serving customers among large contractors, and again is due to the use of specialized high compaction equipment.

### TABLE 4.3

### NATIONAL ESTIMATE OF CUSTOMER TYPES SERVICED BY THE PRIVATE SECTOR BY CONTRACTOR SIZE

| Type of Customer | Size of Contractor | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 truck | 2-3 trucks | 4-5 trucks | 6-9 trucks | 10-19 trucks | 20-49 trucks | 50 or more trucks | Total |
| Total Contractors | 2,608 | 3,193 | 1,421 | 1,261 | 982 | 405 | 157 | 10,027 |
| Total Customers | 755,401 | 2,368,715 | 2,002,673 | 3,445,927 | 7,242,717 | 5,571,637 | 5,986,477 | 27,351,013 |
| Single Family Homes | 630,421 | 2,031,357 | 1,751,170 | 2,988,663 | 6,350,910 | 4,786,531 | 4,833,229 | 23,348,933 |
| Duplexes - 4 Units | 36,931 | 62,920 | 47,874 | 142,254 | 357,002 | 362,474 | 358,370 | 1,367,825 |
| Apartments - 5 Units or more | 16,762 | 52,220 | 43,194 | 43,194 | 68,982 | 99,282 | 321,699 | 644,688 |
| Commercial* | 79,081 | 238,565 | 174,572 | 268,017 | 446,558 | 334,385 | 733,894 | 2,275,528 |
| Industrial | 8,968 | 35,873 | 29,057 | 46,993 | 88,247 | 88,247 | 60,984 | 358,727 |

* The figures for Commercial Customers include Apartments of five or more Units.

### TABLE 4.4

### MEAN NUMBER OF CUSTOMER TYPES SERVICES BY THE PRIVATE SECTOR BY CONTRACTOR SIZE

| Type of Customer | Size of Contractor | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 truck | 2-3 trucks | 4-5 trucks | 6-9 trucks | 10-19 trucks | 20-49 trucks | 50 or more trucks | Total |
| Total Contractors | 2,608 | 3,193 | 1,421 | 1,261 | 982 | 405 | 157 | 10,027 |
| Total Customers | 290 | 742 | 1,409 | 2,733 | 7,375 | 13,757 | 38,130 | 2,728 |
| Single Family Homes | 242 | 636 | 1,232 | 2,370 | 6,467 | 11,819 | 30,785 | 2,329 |
| Duplexes - 4 Units | 14 | 20 | 34 | 113 | 364 | 895 | 2,283 | 136 |
| Apartments - 5 Units or more | 6 | 16 | 30 | 34 | 70 | 245 | 2,049 | 64 |
| Commercial* | 30 | 75 | 123 | 213 | 455 | 826 | 4,674 | 227 |
| Industrial | 3 | 11 | 20 | 37 | 90 | 218 | 388 | 36 |

*The figures for Commercial Customers include Apartments of five or more units.

### TABLE 4.5

### PERCENT DISTRIBUTION OF CUSTOMER TYPES SERVICED BY THE PRIVATE SECTOR BY CONTRACTOR SIZE

| Type of Customer | Size of Contractor | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 truck | 2-3 trucks | 4-5 trucks | 6-9 trucks | 10-19 trucks | 20-49 trucks | 50 or more trucks | Total |
| Distribution of Total Contractors | 26.0% | 31.8% | 14.1% | 12.6% | 9.8% | 4.0% | 1.6% | 100% |
| Share of Total Customers | 2.8 | 8.7 | 7.3 | 12.6 | 26.5 | 20.4 | 21.8 | 100 |
| Single Family Homes | 2.7 | 8.7 | 7.5 | 12.8 | 27.2 | 20.5 | 20.7 | 100 |
| Duplexes - 4 Units | 2.7 | 4.6 | 3.5 | 10.4 | 26.1 | 26.5 | 26.2 | 100 |
| Apartments - 5 or more Units | 2.6 | 8.1 | 6.7 | 6.7 | 10.7 | 15.4 | 49.9 | 100 |
| Commercial | 3.5 | 10.5 | 7.7 | 11.8 | 19.6 | 14.7 | 32.3 | 100 |
| Industrial | 2.5 | 10.0 | 8.1 | 13.1 | 24.6 | 24.6 | 17.0 | 100 |
| Total Customers* | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| Single Family Homes | 83.5 | 85.8 | 87.4 | 86.7 | 87.7 | 85.5 | 80.7 | 85.4 |
| Duplexes - 4 Units | 4.9 | 2.7 | 2.4 | 4.1 | 4.9 | 6.8 | 6.0 | 5.0 |
| Apartments - 5 or more Units | 2.2 | 2.3 | 2.2 | 1.3 | 1.0 | 1.8 | 5.4 | 2.4 |
| Commercial | 10.5 | 10.1 | 8.7 | 7.8 | 6.2 | 6.1 | 12.3 | 8.3 |
| Industrial | 1.2 | 1.5 | 1.5 | 1.4 | 1.2 | 1.6 | 1.0 | 1.3 |

* Numbers total to more than 100 percent since Apartments of five or more Units are also included in the category commercial customers.

The disproportionately large share of the private collectors' customer market served by the large contractors is relatively consistent across all customer categories. For example, the shares of duplexes and apartments are 78.8 percent and 76.0 percent, respectively (Table 4.6).

### TABLE 4.6

### PROPORTION OF CONTRACTORS, AND CUSTOMER TYPES COLLECTED

| % Contractors | Cumulative % | % Residential Customers | Cumulative % | % Commercial Customers | Cumulative % | % Apartments 5 or more Units | Cumulative % | % Industrial Customers | Cumulative % |
|---|---|---|---|---|---|---|---|---|---|
| 1.6 | 1.6 | 21.0 | 21.0 | 32.3 | 32.3 | 49.9 | 49.9 | 17.0 | 17.0 |
| 4.0 | 5.6 | 20.8 | 41.8 | 14.7 | 47.0 | 15.4 | 65.3 | 24.6 | 41.6 |
| 9.8 | 15.4 | 27.1 | 68.9 | 19.6 | 66.6 | 10.7 | 76.0 | 24.6 | 66.2 |
| 12.6 | 28.0 | 12.7 | 81.6 | 11.8 | 78.4 | 6.7 | 82.7 | 13.1 | 79.3 |
| 14.1 | 42.1 | 7.3 | 88.9 | 7.7 | 86.1 | 6.7 | 89.4 | 8.1 | 87.4 |
| 31.8 | 73.9 | 8.5 | 97.4 | 10.5 | 96.6 | 8.1 | 97.5 | 10.0 | 97.4 |
| 26.0 | 99.9 | 2.7 | 100.1 | 3.5 | 100.1 | 2.6 | 100.1 | 2.5 | 99.9 |

## CUSTOMERS AND TONNAGE SHARES

Single family, residential customers represent about 85 percent of the total customers collected by contractors of all sizes. Residential customers (single family and 2 to 4 unit apartments) represent 90 percent of those served and 21.9 percent of the total tonnage. The bulk (33.7%) of the tonnage comes from commercial customers, while industrial customers account for 31.3 percent of the total tonnage (Table 4.7). Clearly, the use of higher capacity and more sophisticated equipment and the existence of more wastes of higher density associated with commercial and industrial collection explain the inverse relationships between the proportions of customers and wastes.

TABLE 4.7

TONNAGE SHARES BY CUSTOMER TYPES

| Type of Customer | Share of Customers | Share of Tons |
|---|---|---|
| Residential | 90.3% | 21.9% |
| Commercial | 8.3 | 33.7 |
| Industrial | 1.3 | 31.3 |

While single family homes comprise over 80 percent of the total customers for all contractor size groupings, this share is lowest for contractors with 50 or more trucks. Contractors of this size service a higher percent of commercial customers (12.3%) and apartments (5.4%) than any other group (Table 4.5). On the other hand, commercial customers comprise a disproportionately large share of the total customers serviced by contractors with 1-3 trucks. This results from the fact that 43.8 percent of the contractors with 1-3 trucks collect commercial and industrial customers exclusively.

## CUSTOMERS BY DAILY TONNAGE

While single family homes account for approximately 85 percent of the average contractor's total customers, contractors collecting either 1-6 tons, or over 1,000 tons do not follow the norm. Among contractors collecting 1-6 tons per day, single family homes comprise a significantly lower percent of their customers (41.4%), and duplexes (16.2%) and commercial customers (38.8%) account for significantly larger shares of the customers (Table 4.10). Commercial customers, as a whole, and the subcategory of apartments in particular, comprise larger shares of total customers for contractors collecting a small number of tons (12 or less) and for those collecting 500 or more tons.

TABLE 4.8

NATIONAL ESTIMATE OF CUSTOMER TYPES SERVICES BY THE PRIVATE SECTOR BY TONS COLLECTED

| Type of Customer | Number of Tons Collected Per Day | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1-6 | 7-12 | 13-24 | 25-49 | 50-99 | 100-249 | 250-499 | 500-999 | 1000 or more | Total |
| Total Contractors | 2,636 | 1,726 | 1,865 | 1,238 | 1,099 | 918 | 277 | 161 | 110 | 10,027 |
| Total Customers | 169,175 | 968,062 | 2,581,993 | 2,806,308 | 3,816,289 | 6,741,707 | 3,794,637 | 3,887,672 | 2,604,802 | 27,351,013 |
| Single Family Homes | 70,047 | 817,213 | 2,218,149 | 2,521,685 | 3,455,642 | 5,790,535 | 3,362,246 | 3,268,851 | 1,807,915 | 23,348,933 |
| Duplexes - 4 Units | 27,357 | 27,357 | 123,104 | 77,966 | 84,805 | 426,761 | 209,277 | 212,013 | 177,817 | 1,367,825 |
| Apartments 5 or more Units | 9,026 | 21,919 | 43,839 | 42,549 | 52,864 | 72,205 | 42,549 | 194,051 | 165,685 | 644,683 |
| Commercial | 65,673 | 106,632 | 215,270 | 183,698 | 224,903 | 436,523 | 178,991 | 375,957 | 485,890 | 2,275,528 |
| Industrial | 6,098 | 16,860 | 25,470 | 22,959 | 50,939 | 87,888 | 44,123 | 30,851 | 73,180 | 358,727 |

* The figures for Commercial Customers include Apartments of five or more Units

## TABLE 4.9

## MEAN NUMBER OF CUSTOMER TYPES SERVICED BY THE PRIVATE SECTOR BY TONS COLLECTED

| Type of Customer | Number of Tons Collected Per Day | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1-6 | 7-12 | 13-24 | 25-49 | 50-99 | 100-249 | 250-499 | 500-999 | 1000 or more | Total |
| Total Contractors | 2,636 | 1,726 | 1,865 | 1,238 | 1,099 | 918 | 277 | 161 | 110 | 10,027 |
| Total Customers | 64 | 561 | 1,384 | 2,267 | 3,473 | 7,344 | 13,699 | 24,147 | 23,680 | 2,728 |
| Single Family Homes | 27 | 473 | 1,189 | 2,037 | 3,144 | 6,308 | 12,138 | 20,303 | 16,981 | 2,329 |
| Duplexes - 4 Units | 10 | 16 | 66 | 63 | 77 | 465 | 756 | 1,317 | 1,617 | 136 |
| Apartments 5 or more Units | 3 | 13 | 24 | 34 | 48 | 79 | 154 | 1,205 | 1,506 | 64 |
| Commercial * | 25 | 62 | 115 | 148 | 205 | 476 | 646 | 2,335 | 4,417 | 227 |
| Industrial | 2 | 10 | 14 | 19 | 46 | 96 | 159 | 192 | 665 | 36 |

* The figures for Commercial Customers include Apartments of five or more Units

## TABLE 4.10

## PERCENT DISTRIBUTION OF CUSTOMER TYPES SERVICED BY THE PRIVATE SECTOR BY TONS COLLECTED

| Type of Customer | Number of Tons Collected Per Day | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1-6 | 7-12 | 13-24 | 25-49 | 50-99 | 100-249 | 250-499 | 500-999 | 1,000 or more | Total |
| Distribution of Total Contractors | 26.3% | 17.2% | 18.6% | 12.3% | 11.0% | 9.2% | 2.8% | 1.6% | 1.1% | 100% |
| Share of Total Customers | 0.6 | 3.5 | 9.4 | 10.3 | 14.0 | 24.6 | 13.9 | 14.2 | 9.5 | 100 |
| Single Family Homes | 0.3 | 3.5 | 9.5 | 10.8 | 14.8 | 24.8 | 14.4 | 14.0 | 8.0 | 100 |
| Duplexes - 4 Units | 2.0 | 2.0 | 9.0 | 5.7 | 6.2 | 31.2 | 15.3 | 15.5 | 13.0 | 100 |
| Apartments - 5 or more Units | 1.4 | 3.4 | 6.8 | 6.6 | 8.2 | 11.2 | 6.6 | 30.1 | 25.7 | 100 |
| Commercial | 2.9 | 4.7 | 9.5 | 8.1 | 9.9 | 19.2 | 7.9 | 16.5 | 21.4 | 100 |
| Industrial | 1.7 | 4.7 | 7.1 | 6.4 | 14.2 | 24.5 | 12.3 | 8.6 | 20.4 | 100 |
| Total Customers * | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| Single Family Homes | 41.4 | 84.4 | 85.9 | 89,9 | 90.5 | 85,9 | 88.6 | 84.1 | 71.7 | 85.4 |
| Duplexes - 4 Units | 16.2 | 2.8 | 4,8 | 2.8 | 2.2 | 6.3 | 5.5 | 5.5 | 6.8 | 5.0 |
| Apartments - 5 or more Units | 5.3 | 2.3 | 1.7 | 1.5 | 1.4 | 1.1 | 1.1 | 5.0 | 6.4 | 2.4 |
| Commercial | 38.8 | 11.0 | 8.3 | 6.5 | 5.9 | 6,5 | 4.7 | 9.7 | 18.7 | 8.3 |
| Industrial | 3.6 | 1.7 | 1.0 | 0.8 | 1.3 | 1.3 | 1.2 | 0.8 | 2.8 | 1.3 |

* Numbers total to more than 100 percent since Apartments of five or more Units are also included in the category Commercial Customers.

Single family households represent 71.7 percent of the customers of organizations collecting 1000 tons or more per day. This category of firms collect the largest number and percentage (21.4%) of the total commercial customers served by the private sector and are second in the industrial category on the same criteria. Thus, commercial and industrial wastes provide the base for high daily tonnage.

## CUSTOMERS BY MIX OF COLLECTION

The data on customer types by mix of collection reveal some interesting trends. Exclusively commercial-industrial contractors serve only 3.0 percent of the available customers (Table 4.13) yet operate 33.8 percent of the trucks (Table 5.16) and collect 41.6 percent of the total tonnage (Table 3.12). Obviously, the percent of customers served within this context means little. Most reflective of the exclusively commercial-industrial operators' contribution is the fact that these companies serve over one-fourth, or 632,000, of the commercial customers and one-half or 182,000, of the industrial customers. In total, commercial and industrial customers provide two-thirds of the daily waste handled by private sector.

TABLE 4.11

NATIONAL ESTIMATE OF CUSTOMER TYPES SERVICED BY THE PRIVATE SECTOR BY MIX OF COLLECTION

| Type of Customer | % Residential Collection | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 100% | 80-99% | 60-79% | 40-59% | 20-39% | 1-19% | 100%* | Total |
| Total Contractors | 375 | 1,835 | 1,402 | 1,081 | 661 | 522 | 4,143 | 10,027 |
| Total Customers | 1,233,294 | 7,709,609 | 6,880,401 | 6,511,836 | 3,946,073 | 254,029 | 814,044 | 27,351,013 |
| Single Family Homes | 1,214,144 | 6,981,331 | 5,930,629 | 5,837,233 | 3,245,502 | 140,094 | -- | 23,348,933 |
| Duplexes - 4 Units | 19,150 | 425,394 | 285,875 | 285,875 | 341,956 | 8,207 | -- | 1,367,825 |
| Apartments - 5 or more Units | -- | 76,718 | 203,721 | 154,080 | 76,718 | 16,762 | 116,044 | 644,688 |
| Commercial** | -- | 292,840 | 631,612 | 349,627 | 280,413 | 88,150 | 632,887 | 2,275,528 |
| Industrial | -- | 10,044 | 32,285 | 39,101 | 78,202 | 17,578 | 181,157 | 358,727 |

* Commercial and Industrial

** The figures for Commercial Customers include Apartments of five or more Units.

## TABLE 4.12

## MEAN NUMBER OF CUSTOMER TYPES SERVICED BY THE PRIVATE SECTOR BY MIX OF COLLECTION

| Type of Customer | % Residential Collection | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 100% | 80-99% | 60-79% | 40-59% | 20-39% | 1-19% | 100%* | Total |
| Total Contractors | 375 | 1,835 | 1,402 | 1,081 | 661 | 522 | 4,143 | 10,027 |
| Total Customers | 3,289 | 4,201 | 4,908 | 6,024 | 5,970 | 487 | 196 | 2,728 |
| Single Family Homes | 3,238 | 3,805 | 4,230 | 5,400 | 4,910 | 268 | --- | 2,329 |
| Duplexes - 4 Units | 51 | 232 | 204 | 264 | 517 | 16 | --- | 136 |
| Apartments - 5 or more Units | --- | 42 | 145 | 143 | 116 | 32 | 28 | 64 |
| Commercial** | --- | 160 | 451 | 323 | 424 | 169 | 153 | 227 |
| Industrial | --- | 5 | 23 | 36 | 118 | 34 | 44 | 3 |

* Commercial and Industrial

** The figures for Commercial Customers include Apartments of five or more Units.

## TABLE 4.13

## PERCENT DISTRIBUTION OF CUSTOMER TYPES SERVICED BY THE PRIVATE SECTOR BY MIX OF COLLECTION

| Type of Customers | % Residential Collection | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 100% | 80-99% | 60-70% | 40-59% | 20-39% | 1-19% | 100%* | Total |
| Distribution of Total Contractors | 3.7% | 18.3% | 14.0% | 10.8% | 6.6% | 5.2% | 41.3% | 100% |
| Share of Total Customers | 4.5 | 28.2 | 25.2 | 23.8 | 14.4 | 0.9 | 3.0 | 100 |
| Single Family Homes | 5.2 | 29.9 | 25.4 | 25.0 | 13.9 | 0.6 | -- | 100 |
| Duplexes - 4 Units | 1.4 | 31.1 | 20.9 | 20.9 | 25.0 | 0.6 | -- | 100 |
| Apartments - 5 or more Units | -- | 11.9 | 31.6 | 23.9 | 11.9 | 2.6 | 18.0 | 100 |
| Commercial | -- | 12.9 | 27.8 | 15.4 | 12.3 | 3.9 | 27.8 | 100 |
| Industrial | -- | 2.8 | 9.0 | 10.9 | 21.8 | 4.9 | 50.5 | 100 |
| Total Customers** | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| Single Family Homes | 98.4 | 90.6 | 86.2 | 89.6 | 82.2 | 55.1 | -- | 85.3 |
| Duplexes - 4 Units | 1.6 | 5.5 | 4.2 | 4.4 | 8.7 | 3.2 | -- | 5.0 |
| Apartments - 5 or more Units | -- | 1.0 | 3.0 | 2.4 | 1.9 | 6.6 | 14.3 | 2.4 |
| Commercial | -- | 3.8 | 9.2 | 5.4 | 7.1 | 34.7 | 77.7 | 8.3 |
| Industrial | -- | 0.1 | 0.5 | 0.6 | 2.0 | 6.9 | 22.3 | 1.3 |

* Commercial and Industrial

** Numbers total to more than 100 percent since Apartments of five or more Units are also included in the category Commercial Customers.

Those contractors whose tonnage is half residential and those whose tonnage is 20-39 percent residential each serve about 6000 customers. This coincides with their larger number of trucks which average 8.18 and 10.48 per contractor, respectively (Table 4.3). The 20-39 percent group is distinct from the others by virtue of its heavy involvement in industrial collection. This group is second only to the purely commercial contractor and collects 21.8 percent of all industrial customers. Exclusively residential contractors collect, on the average, about 1000-1100 residential customers per truck (Table 4.5).

## CUSTOMERS BY REGIONAL AND CITY SIZE CHARACTERISTICS

The proportion of all customers collected is highest for SMSA's of over one million (58%), and decreases as SMSA size decreases (Table 4. 16). This indicates a concentration of service by the private sector in large SMSA's. Smaller cities, particularly in the South, often have municipal collection. Contractors in SMSA's of over one million collect 527, 999 apartments out of the 644, 688 (82%), and 254, 337 of the 358, 727 industrial customers (71%).

Single family homes comprise the largest share of customers (91%) for contractors in non-SMSA's, and over 80 percent of the total customers for all size SMSA's. Commercial customers make up the second highest share of customers for all SMSA's except those cities of 100, 000 to 249, 999 where duplex apartments are a higher share of total customers served than commercial customers. The portion that commercial and industrial customers comprise becomes a larger share of total customers as SMSA size increases.

TABLE 4.14

NATIONAL ESTIMATE OF CUSTOMER TYPES SERVICED BY THE PRIVATE SECTOR BY SMSA SIZE

| Type of Customer | SMSA Size | | | | | | |
|---|---|---|---|---|---|---|---|
| | over 1,000,000 | 500,000-1,000,000 | 250,000-499,999 | 100,000-249,999 | 50,000-99,999 | Non SMSA | Total |
| Total Contractors | 4,456 | 1,311 | 1,498 | 1,017 | 149 | 1,596 | 10,027 |
| Total Customers | 15,848,467 | 3,775,501 | 2,610,535 | 2,523,331 | 284,188 | 2,286,415 | 27,351,013 |
| Single Family Homes | 13,192,147 | 3,245,502 | 2,334,893 | 2,241,498 | 233,489 | 2,078,055 | 23,348,933 |
| Duplexes - 4 Units | 852,155 | 181,921 | 98,483 | 160,036 | 6,839 | 68,391 | 1,367,825 |
| Apartments - 5 or more Units | 527,999 | 52,220 | 30,945 | 18,696 | 1,289 | 13,538 | 644,688 |
| Commercial | 1,549,828 | 291,758 | 158,146 | 109,242 | 39,914 | 127,414 | 2,275,528 |
| Industrial | 254,337 | 56,320 | 19,013 | 12,555 | 3,946 | 12,555 | 358,727 |

The figures for Commercial Customers include Apartments of five or more Units.

## TABLE 4.15

## MEAN NUMBER OF CUSTOMER TYPES SERVICED BY THE PRIVATE SECTOR BY SMSA SIZE

| Type of Customer | SMSA Size | | | | | | |
|---|---|---|---|---|---|---|---|
| | over 1,000,000 | 500,000-1,000,000 | 250,000 499,999 | 100,000-249,999 | 50,000-99,999 | Non SMSA | Total |
| Total Contractors | 4,456 | 1,311 | 1,498 | 1,017 | 149 | 1,596 | 10,027 |
| Total Customers | 3,555 | 2,880 | 1,743 | 2,481 | 1,907 | 1,432 | 2,728 |
| Single Family Homes | 2,959 | 2,476 | 1,559 | 2,204 | 1,567 | 1,301 | 2,327 |
| Duplexes - 4 Units | 191 | 139 | 66 | 157 | 46 | 43 | 136 |
| Apartments - 5 or more Units | 118 | 40 | 21 | 18 | 9 | 8 | 64 |
| Commercial * | 348 | 223 | 106 | 107 | 268 | 80 | 227 |
| Industrial | 57 | 43 | 13 | 12 | 26 | 8 | 36 |

* The figures for Commercial Customers include Apartments of five or more Units.

## TABLE 4.16

## PERCENT DISTRIBUTION OF CUSTOMER TYPES SERVICED BY THE PRIVATE SECTOR BY SMSA SIZE

| Type of Customer | SMSA Size | | | | | | |
|---|---|---|---|---|---|---|---|
| | over 1,000,000 | 500,000-1,000,000 | 250,000-499,999 | 100,000-249,999 | 50,000-99,999 | Non SMSA | Total |
| Distribution of Total Contractors | 44.5% | 13.1% | 14.9% | 10.1% | 1.5% | 15.9% | 100% |
| Share of Total Customers | 58.9 | 13.8 | 9.6 | 9.2 | 1.0 | 8.4 | 100 |
| Single Family Homes | 56.5 | 13.9 | 10.0 | 9.6 | 1.0 | 8.9 | 100 |
| Duplexes - 4 Units | 62.3 | 13.3 | 7.2 | 11.7 | 0.5 | 5.0 | 100 |
| Apartments - 5 or more Units | 81.9 | 8.1 | 4.8 | 2.9 | 0.2 | 2.1 | 100 |
| Commercial | 68.1 | 12.8 | 7.0 | 4.8 | 1.8 | 5.6 | 100 |
| Industrial | 70.9 | 15.7 | 5.3 | 3.5 | 1.1 | 3.5 | 100 |
| Total Customers* | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| Single Family Homes | 83.2 | 86.0 | 89.4 | 88.8 | 82.2 | 90.8 | 85.3 |
| Duplexes - 4 Units | 5.4 | 4.8 | 3.8 | 6.3 | 2.4 | 3.0 | 5.0 |
| Apartments - 5 or more Units | 3.3 | 1.4 | 1.2 | 0.7 | 0.5 | 0.6 | 2.4 |
| Commercial | 9.8 | 7.7 | 6.1 | 4.3 | 14.0 | 5.6 | 8.3 |
| Industrial | 1.6 | 1.5 | 0.7 | 0.5 | 1.4 | 0.6 | 1.3 |

* Numbers total to more than 100 percent since Apartments of five or more Units are also included in the category Commercial Customers.

The distribution of customer types by region (Table 4.19) indicates that the 1,555 contractors in the West collect the largest share of the total customers serviced by the private sector. Western region contractors account for 27 percent of the single family homes, 42 percent of the duplexes, 56 percent of all apartment buildings, and 42 percent of the commercial customers in the U.S. served by private contractors. This may be explained by the practice of franchising of both residential and commercial collection by local governments in the Western region.

The Midwest and North Atlantic contractors account for the second and third highest share of customers, respectively.

Single family homes represent 93.2 percent of the total customers collected by the private sector in the Mid-Atlantic and 72.2 percent of the customers in the Northeast. Duplexes, on the other hand, comprise 21.6 percent of the customers in the Northeast, which is almost three times the proportion in any other region. The Mountain, South Central, and West contractors' collection mixes include the highest proportions of commercial customers, with the West also servicing the highest proportion of apartments. Industrial customers comprise a higher share of total customers in the Northeast (1.8%) and Midwest (1.7%) than in any other regions. It must, of course, be noted that industrial tonnage is a much higher proportion of the total tonnage than is the total proportion of industrial customers to the total number of customers.

TABLE 4.17

NATIONAL ESTIMATE OF CUSTOMER TYPES SERVICED BY THE PRIVATE SECTOR BY REGION

| Type of Customer | Region | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Northeast | North Atlantic | Mid-Atlantic | South Atlantic | Mid-West | North Central | South Central | Mountain | West | Total |
| Total Contractors | 529 | 2,024 | 644 | 373 | 2,401 | 1,603 | 507 | 391 | 1,555 | 10,027 |
| Total Customers | 1,422,169 | 4,555,760 | 1,778,464 | 1,726,018 | 6,165,367 | 1,820,021 | 1,281,752 | 583,230 | 8,040,140 | 27,351,013 |
| Single Family Homes | 1,027,353 | 4,109,412 | 1,657,774 | 1,564,379 | 5,463,650 | 1,587,727 | 1,074,051 | 490,328 | 6,397,608 | 23,348,933 |
| Duplexes - 4 Units | 307,761 | 136,783 | 41,035 | 42,403 | 127,208 | 93,012 | 35,563 | 6,839 | 575,854 | 1,367,825 |
| Apartments - 5 or more Units | 9,026 | 68,982 | 19,341 | 14,828 | 98,637 | 37,392 | 16,117 | 16,117 | 363,604 | 644,688 |
| Commercial | 61,944 | 239,255 | 75,709 | 103,093 | 471,554 | 130,673 | 159,941 | 79,606 | 954,038 | 2,275,528 |
| Industrial | 25,111 | 70,310 | 3,946 | 16,143 | 102,955 | 8,609 | 12,197 | 6,457 | 112,640 | 358,727 |

* The figures for Commercial Customers include Apartments of five or more Units

## TABLE 4.18

## MEAN NUMBER OF CUSTOMER TYPES SERVICED BY THE PRIVATE SECTOR BY REGION

| Type of Customer | Region | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Northeast | North Atlantic | Mid-Atlantic | South Atlantic | Mid-West | North Central | South Central | Mountain | West | Total |
| Total Contractors | 529 | 2,024 | 644 | 373 | 2,401 | 1,603 | 507 | 391 | 1,555 | 10,027 |
| Total Customers | 2,688 | 2,251 | 2,762 | 4,627 | 2,568 | 1,135 | 2,528 | 1,492 | 5,171 | 2,728 |
| Single Family Homes | 1,942 | 2,030 | 2,574 | 4,194 | 2,276 | 990 | 2,118 | 1,254 | 4,114 | 2,329 |
| Duplexes - 4 Units | 582 | 68 | 64 | 114 | 53 | 58 | 70 | 17 | 370 | 136 |
| Apartments - 5 or more Units | 17 | 34 | 30 | 40 | 41 | 23 | 32 | 41 | 234 | 64 |
| Commercial | 117 | 118 | 118 | 276 | 196 | 82 | 315 | 204 | 614 | 227 |
| Industrial | 47 | 35 | 6 | 43 | 43 | 5 | 24 | 17 | 72 | 36 |

* The figures for Commercial Customers include Apartments of five or more Units

## TABLE 4.19

## PERCENT DISTRIBUTION OF CUSTOMER TYPES SERVICED BY THE PRIVATE SECTOR BY REGION

| Type of Customer | Region | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Northeast | North Atlantic | Mid-Atlantic | South Atlantic | Mid-West | North Central | South Central | Mountain | West | Total |
| Distribution of Total Contractors | 5.3% | 20.2% | 6.4% | 3.7% | 23.9% | 16.0% | 5.1% | 3.9% | 15.5% | 100% |
| Share of Total Customers | 5.2 | 16.7 | 6.5 | 6.3 | 22.5 | 6.7 | 4.7 | 2.1 | 29.4 | 100 |
| Single Family Homes | 4.4 | 17.6 | 7.1 | 6.7 | 23.4 | 6.8 | 4.6 | 2.1 | 27.4 | 100 |
| Duplexes - 4 Units | 22.5 | 10.0 | 3.0 | 3.1 | 9.3 | 6.8 | 2.6 | .5 | 42.1 | 100 |
| Apartments - 5 or more Units | 1.4 | 10.7 | 3.0 | 2.3 | 15.3 | 5.8 | 2.5 | 2.5 | 56.4 | 100 |
| Commercial | 2.7 | 10.5 | 3.2 | 4.5 | 20.7 | 5.7 | 7.1 | 3.5 | 42.1 | 100 |
| Industrial | 7.0 | 19.6 | 1.1 | 4.5 | 28.7 | 2.4 | 3.4 | 1.8 | 31.4 | 100 |
| Total Customers* | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| Single Family Homes | 72.2 | 90.2 | 93.2 | 90.6 | 88.6 | 87.2 | 83.8 | 84.1 | 79.6 | 85.3 |
| Duplexes - 4 Units | 21.6 | 3.0 | 2.3 | 2.5 | 2.1 | 5.1 | 2.8 | 1.2 | 7.2 | 5.0 |
| Apartments - 5 or more Units | 0.6 | 1.5 | 1.1 | 0.9 | 1.6 | 2.1 | 1.3 | 2.8 | 4.5 | 2.4 |
| Commercial | 4.4 | 5.3 | 4.3 | 6.0 | 7.7 | 7.2 | 12.5 | 13.7 | 11.9 | 8.3 |
| Industrial | 1.8 | 1.5 | 0.2 | 0.9 | 1.7 | 0.5 | 1.0 | 1.1 | 1.4 | 1.3 |

* Numbers total to more than 100 percent since Apartments of Five or more Units are also included in the category Commercial Customers.

## TYPE OF WASTE COLLECTED AND FREQUENCY

Virtually all contractors report collecting rubbish. In most instances rubbish is combined with garbage and called "combined collection". Table 4.20 indicates the types of wastes collected, the mean number of trucks, and the mean tons collected daily.

TABLE 4.20

SIZE OF CONTRACTOR INDICATORS BY TYPE OF WASTES COLLECTED IN PRIVATE SECTOR

| Type of Waste | Number of Contractors Who Collect | Percent of Contractors Who Collect | Mean Number of Trucks | Mean Number of Tons Daily | Tons Per Truck |
|---|---|---|---|---|---|
| Rubbish | 9,950 | 99.2% | 6.16 | 72.29 | 11.4 |
| Garbage | 7,889 | 78.7 | 7.12 | 81.26 | 11.4 |
| Yard Refuse | 7,807 | 77.9 | 6.78 | 76.82 | 11.3 |
| Bulky Wastes | 7,623 | 76.0 | 6.87 | 81.17 | 11.8 |
| Ashes | 6,405 | 63.9 | 7.40 | 88.17 | 11.9 |
| Construction and Demolition Wastes | 5,156 | 51.4 | 7.94 | 102.94 | 13.0 |
| Special Wastes | 3,113 | 31.0 | 9.93 | 152.02 | 15.3 |
| Dead Animals | 1,733 | 17.3 | 10.49 | 127.69 | 12.2 |
| Street Refuse | 1,727 | 17.2 | 11.44 | 146.98 | 12.9 |
| Animal and Agriculture Wastes | 1,587 | 15.8 | 13.59 | 183.55 | 13.5 |
| Sewage Treatment Residues | 394 | 3.9 | 14.09 | 239.85 | 17.0 |
| Abandoned Vehicles | 375 | 3.6 | 15.08 | 220.19 | 14.6 |

While the present data cannot fully explain all conditions, the relationship of mean-tonnage-to-mean-trucks is of interest. The differences in tons per truck may be a function of the type of waste handled and/or the type of equipment used. Approximately 35 percent of the residential customers require twice a week collection and nearly 60 percent receive once a week collection.

TABLE 4.21

PERCENT OF COLLECTION FREQUENCY BY CUSTOMER TYPE

| Frequency of Collection | Single Family Homes | Duplexes-4 Units | Apartments-5 or more Units |
|---|---|---|---|
| Less Than Once a Week | 4.5% | 3.8% | 0.5% |
| Once A Week | 58.8 | 50.3 | 22.3 |
| Twice a Week | 34.7 | 42.5 | 40.4 |
| Over Twice a Week | 1.4 | 3.3 | 37.1 |

One of the major variables which affects the frequency of collection is region of the country (Table 4.25). This indicates that collection frequency requirements are subject to local regulations and competitive practices. Size of contractor, mix of collection, and daily tonnage are of lesser importance as determinants of collection frequency.

TABLE 4.22

MEAN COLLECTION FREQUENCY (TIMES PER WEEK) OF HOUSEHOLD REFUSE FROM SINGLE FAMILY HOMES BY CONTRACTOR SIZE AMONG THE PRIVATE SECTOR

| Types of Household Refuse | Size of Contractor | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 truck | 2-3 trucks | 4-5 trucks | 6-9 trucks | 10-19 trucks | 20-49 trucks | 50 or more trucks | Total |
| Combined Collection | 1.34 | 1.35 | 1.36 | 1.50 | 1.38 | 1.35 | 1.27 | 1.39 |
| Garbage | 1.33 | 1.38 | 1.25 | 1.55 | 1.39 | 1.35 | 1.22 | 1.39 |
| Rubbish | 1.24 | 1.32 | 1.26 | 1.46 | 1.33 | 1.36 | 1.25 | 1.33 |
| Yard Refuse | 1.29 | 1.32 | 1.34 | 1.44 | 1.36 | 1.28 | 1.17 | 1.35 |
| Ashes | 1.25 | 1.30 | 1.31 | 1.49 | 1.39 | 1.22 | 1.17 | 1.33 |

## TABLE 4.23

### MEAN COLLECTION FREQUENCY (TIMES PER WEEK) OF HOUSEHOLD REFUSE FROM SINGLE FAMILY HOMES BY DAILY TONNAGE AMONG THE PRIVATE SECTOR

| Types of Household Refuse | Number of Tons Collected Per Day | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1-6 | 7-12 | 13-24 | 25-49 | 50-99 | 100-249 | 250-500 | 500-999 | 1,000 or more | |
| Combined Collection | 1.24 | 1.34 | 1.53 | 1.36 | 1.47 | 1.30 | 1.38 | 1.44 | 1.40 | 1.39 |
| Garbage | 1.21 | 1.37 | 1.47 | 1.36 | 1.53 | 1.32 | 1.31 | 1.33 | 1.25 | 1.39 |
| Rubbish | 1.18 | 1.31 | 1.38 | 1.38 | 1.48 | 1.24 | 1.40 | 1.14 | 1.33 | 1.33 |
| Yard Refuse | 1.22 | 1.34 | 1.44 | 1.36 | 1.40 | 1.26 | 1.40 | 1.11 | 1.33 | 1.35 |
| Ashes | 1.20 | 1.30 | 1.46 | 1.33 | 1.45 | 1.21 | 1.25 | 1.11 | 1.33 | 1.33 |

## TABLE 4.24

### MEAN COLLECTION FREQUENCY (TIMES PER WEEK) OF HOUSEHOLD REFUSE FROM SINGLE FAMILY HOMES BY MIX OF COLLECTION AMONG PRIVATE SECTOR

| Types of Household Refuse | % Residential Collection | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 100% | 80-99% | 60-79% | 40-59% | 20-39% | 1-19% | 100%* | Total |
| Combined Collection | 1.38 | 1.40 | 1.43 | 1.29 | 1.33 | 1.27 | -- | 1.39 |
| Garbage | 1.55 | 1.45 | 1.35 | 1.25 | 1.34 | 1.27 | -- | 1.39 |
| Rubbish | 1.36 | 1.42 | 1.32 | 1.14 | 1.37 | 1.14 | -- | 1.33 |
| Yard Refuse | 1.30 | 1.40 | 1.36 | 1.20 | 1.36 | 1.22 | -- | 1.35 |
| Ashes | 1.33 | 1.38 | 1.35 | 1.20 | 1.28 | 1.18 | -- | 1.33 |

* Commercial and Industrial

## TABLE 4.25

## MEAN COLLECTION FREQUENCY (TIMES PER WEEK) OF HOUSEHOLD REFUSE FROM SINGLE FAMILY HOMES BY REGION AMONG PRIVATE SECTOR

| Types of Household Refuse | Region | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Northeast | North Atlantic | Mid-Atlantic | South Atlantic | Mid-West | North Central | South Central | Mountain | West | Total |
| Combined Collection | 1.33 | 1.37 | 1.97 | 1.94 | 1.28 | 1.32 | 1.80 | 1.00 | 1.21 | 1.39 |
| Garbage | 1.00 | 1.42 | 1.87 | 2.13 | 1.33 | 1.20 | 1.83 | 1.00 | 1.18 | 1.39 |
| Rubbish | 1.10 | 1.34 | 1.89 | 1.25 | 1.25 | 1.19 | 1.62 | 1.00 | 1.20 | 1.33 |
| Yard Refuse | 1.24 | 1.34 | 1.87 | 1.58 | 1.23 | 1.31 | 1.57 | 1.00 | 1.22 | 1.35 |
| Ashes | 1.15 | 1.33 | 1.91 | 1.62 | 1.21 | 1.27 | 1.60 | 1.00 | 1.24 | 1.33 |

## TABLE 4.26

## MEAN COLLCETION FREQUENCY (TIMES PER WEEK) OF HOUSEHOLD REFUSE FROM SINGLE FAMILY HOMES BY SMSA SIZE AMONG PRIVATE SECTOR

| Types of Household Refuse | SMSA Size | | | | | | |
|---|---|---|---|---|---|---|---|
| | over 1,000,000 | 500,000-1,000,000 | 250,000-499,999 | 100,000-249,999 | 50,000-99,999 | Non SMSA | Total |
| Combined Collection | 1.44 | 1.21 | 1.24 | 1.40 | 1.75 | 1.41 | 1.39 |
| Garbage | 1.43 | 1.26 | 1.24 | 1.41 | 1.33 | 1.39 | 1.39 |
| Rubbish | 1.42 | 1.13 | 1.22 | 1.32 | 1.00 | 1.33 | 1.33 |
| Yard Refuse | 1.42 | 1.12 | 1.21 | 1.41 | 1.71 | 1.38 | 1.35 |
| Ashes | 1.43 | 1.12 | 1.19 | 1.42 | 1.57 | 1.32 | 1.33 |

## CURB SERVICE

One of the obvious measures of efficiency of service in residential collection is the number of residences served per day per truck. This measure is markedly affected by the contractor's practice of collecting at the curbside rather than at some more distant location, such as the back or side door. There are significant implications in cost and manpower related to the point of collection. Slightly more than half of the contractors collect at curbside (Table 4.27). Fifty-five percent of the residential customers have curbside collection. The very large and small operators tend to provide more back door collection. Generally this provides a competitive differentiation to small operators and is often a franchise requirement for the large.

TABLE 4.27

NATIONAL ESTIMATE - RESIDENTIAL CUSTOMERS RECEIVING CURB SERVICE FROM PRIVATE SECTOR

| | |
|---|---|
| Number of Private Contractors Who Collect Residential Refuse | 5,883 |
| Number of Private Contractors Who Give Curb Service to Residential Customers | 3,046 |
| Percent of Private Contractors Who Give Curb Service to Residential Customers | 51.8% |
| Number of Residential Customers Receiving Curb Service | 13,570,405 |
| Total Number of Residential Customers Collected By Private Sector | 24,716,758 |
| Percent of Residential Customers Collected By Private Sector Who Receive Curb Service | 54.9% |

Based on our experience during the field effort, curb service is rapidly gaining acceptance nationwide. This is particularly true in the larger cities where cost effects are substantial. It is clear that smaller cities have a lower level of curb service. However, no regional pattern exists.

## TABLE 4.28

### INCIDENCE OF CURB SERVICE FOR RESIDENTIAL CUSTOMERS SERVICED BY THE PRIVATE SECTOR BY CONTRACTOR SIZE

| | Size of Contractor | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 truck | 2-3 trucks | 4-5 trucks | 6-9 trucks | 10-19 trucks | 20-49 trucks | 50 or more trucks | Total |
| Contractors Who Service Residential Customers | 1,347 | 1,865 | 894 | 671 | 682 | 288 | 135 | 5,883 |
| Contractors Who Give Curb Service to Residential Customers | 405 | 920 | 536 | 445 | 475 | 183 | 82 | 3,046 |
| Percent of Contractors Who Give Curb Service | 30.1% | 49.3% | 60.0% | 66.3% | 69.6% | 63.5% | 60.7% | 51.8% |
| Residential Customers Served By Private Sector | 667,352 | 2,076,208 | 1,804,323 | 3.139,028 | 6,698,241 | 5,141,086 | 5,190,519 | 24,716,758 |
| Residential Customers Who Receive Curb Service | 284,979 | 1,017,780 | 868,506 | 1.886,286 | 4,328,959 | 2,836,215 | 2,334,110 | 13,570,405 |
| Percent of Residential Customers Who Receive Curb Service | 42.7% | 49.0% | 48.1% | 60.1% | 64.6% | 55.2% | 45.0% | 54.9% |

## TABLE 4.29

### INCIDENCE OF CURB SERVICE FOR RESIDENTIAL CUSTOMERS SERVICED BY THE PRIVATE SECTOR BY CONTRACTOR MIX OF COLLECTION

| | % Residential Collection | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 100% | 80-99% | 60-79% | 40-59% | 20-39% | 1-19% | 100%* | Total |
| Contractors Who Service Residential Customers | 371 | 1,835 | 1,406 | 1,082 | 665 | 524 | -- | 5,883 |
| Contractors Who Give Curb Service to Residential Customers | 161 | 932 | 810 | 567 | 396 | 183 | -- | 3,046 |
| Percent of Contractors Who Give Curb Service | 43.4% | 50.8% | 57.6% | 52.4% | 59.5% | 34.9% | -- | 51.8% |
| Residential Customers Serviced By the Private Sector | 1,235,838 | 7,390,311 | 6,203,906 | 6,129,756 | 3,608,647 | 148,301 | -- | 24,716,758 |
| Residential Customers Who Receive Curb Service | 773,513 | 3,759,002 | 3,148,334 | 3,216,186 | 2,605,518 | 67,852 | -- | 13,570,405 |
| Percent Residential Customers Who Receive Curb Service | 62.6% | 50.9% | 50.7% | 52.5% | 72.2% | 45.8% | -- | 54.9% |

*Commercial and Industrial

### TABLE 4.30

## INCIDENCE OF CURB SERVICE FOR RESIDENTIAL CUSTOMERS SERVICED BY THE PRIVATE SECTOR BY SMSA SIZE

| | SMSA Size | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1,000,000 or more | 500,000-1.000,000 | 250,000-499,999 | 100,000-249,999 | 50,000-99,999 | Non SMSA | Total |
| Contractors Who Service Residential Customers | 1,853 | 877 | 1,135 | 629 | 106 | 1,288 | 5,883 |
| Contractors Who Give Curb Service To Residential Customers | 1,224 | 335 | 536 | 262 | 40 | 649 | 3,046 |
| Percent of Contractors Who Give Curb Service | 66.1% | 38.2% | 47.2% | 41.7% | 37.7% | 50.4% | 51.8% |
| Residential Customers Serviced By the Private Sector | 14,063,835 | 3,435,629 | 2,422,242 | 2,397,526 | 247,168 | 2,150,358 | 24,716,758 |
| Residential Customers Who Receive Curb Service | 7,789,412 | 1,750,582 | 1,533,456 | 1,384,181 | 94,993 | 1,017,780 | 13,570,405 |
| Percent Residential Customers Who Receive Curb Service | 55.4% | 51.0% | 63.3% | 57.7% | 38.4% | 47.3% | 54.9% |

### TABLE 4.31

## INCIDENCE OF CURB SERVICE FOR RESIDENTIAL CUSTOMERS SERVICED BY THE PRIVATE SECTOR BY REGION

| | Region | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Northeast | North Atlantic | Mid-Atlantic | South Atlantic | Mid-West | North Central | South Central | Mountain | West | Total |
| Contractors Who Service Residential Customers | 312 | 830 | 559 | 288 | 1,547 | 1,130 | 212 | 218 | 788 | 5,883 |
| Contractors Who Give Curb Service to Residential Customers | 171 | 583 | 340 | 181 | 796 | 362 | 96 | 100 | 418 | 3,046 |
| Percent of Contractors Who Give Curb Service | 54.8% | 70.2% | 60.8% | 62.8% | 51.5% | 32.0% | 45.3% | 45.9% | 53.0% | 51.8% |
| Residential Customers Served By Private Sector | 1,330,660 | 4,245,131 | 1,699,226 | 1,605,018 | 5,581,628 | 1,680,020 | 1,119,175 | 490,040 | 6,965,861 | 24,716,758 |
| Residential Customers Who Receive Curb Service | 920,321 | 2,676,553 | 792,263 | 763,699 | 3,231,338 | 169,073 | 871,797 | 138,378 | 4,006,983 | 13,570,405 |
| Percent of Residential Customers Who Receive Curb Service | 69.2% | 63.0% | 46.6% | 47.6% | 57.9% | 10.1% | 77.9% | 28.2% | 57.5% | 54.9% |

# 5

## EQUIPMENT AND MANPOWER

This chapter describes the types of equipment owned and/or serviced by the private sector and the manpower employed for daily operations. Equipment is discussed in terms of packers and non-packers (mainly open trucks), special collection vehicles, and specialized collection equipment. In addition to the total number of each type of truck, information on the size of body, and the direct manpower utilized with each vehicle type appears. The manpower analysis concerns both direct and overhead employees. Data on the daily utilization of equipment and manpower is analyzed by contractor size, daily tonnage collected, mix of collection, SMSA and non-SMSA units, and region.

Tabular output for each variable includes:

- A national estimate of each type of equipment and of employees.
- The percent distribution across and within categories for each variable.

As a further analysis of truck ownership, trends relating to open vs. packer trucks are presented for 1965, 1968, and 1970 by the major variables. Special collection equipment such as roll-off bodies and various forms of containers are examined as a segment of the equipment structure of the private contractor market.

This chapter is structured into the following subsections:

- Chapter Summary
- Equipment Estimates and Utilization

- Manpower Analysis
- Truck Types and Size of Contractor
- Truck Types and Mix of Collection
- Truck Types and Daily Tonnage
- Regional and City Size Characteristics
- Packer - Non-Packer Use Trends
- Specialized Equipment

## CHAPTER SUMMARY

The ownership of total trucks is heavily concentrated among the contractors who operate 10 or more trucks. These contractors comprise 15 percent of the total contractors and own 60 percent of the total trucks. Examining the ownership of specific types of trucks, one finds that packer trucks and special collection vehicles are also more heavily concentrated among the large contractors, while non-packers are more prevalent among small contractors. Large contractors tend to operate large capacity trucks, and collect more refuse per crew member than small contractors.

By region and SMSA size, contractors located in the West, South Atlantic, and South Central, and in SMSA's of over one half million are, on the average, the largest contractors. Contractors located in cities of over 500,000 accounted for 58 percent of the private sector.

The data on trends in ownership of packer and non-packer trucks, since 1965, indicate a substantial increase in the growth rate and number of packer trucks, and a slight decrease in non-packers. While all sizes of contractors have experienced an increase in packers, the decrease in non-packers is much more pronounced among large contractors. There is, however, an increase in non-packers among the smallest contractors.

The specialized equipment serviced by some contractors includes roll-off bodies, stationary containers, stationary compactors, and special containters. Stationary containers and roll-off bodies are the most numerous of the types of special equipment. The contractors who service the specialized equipment tend to be larger contractors with a heavy commercial and industrial collection mix.

## EQUIPMENT ESTIMATES AND UTILIZATION

The private sector operates 61,600 vehicles, and of these slightly over two-thirds are packer trucks, 12 percent are non-packers, and the balance (21%) are special collection vehicles (Figure 5.1). In terms of number of trucks, a large majority of the trucks are packers, which are further subdivided into rear, front, and side loaders. The rear loader is the basic truck used in the industry, constituting 43 percent of all vehicles and 63 percent of all packer type bodies (Figure 5.2).

TABLE 5.1

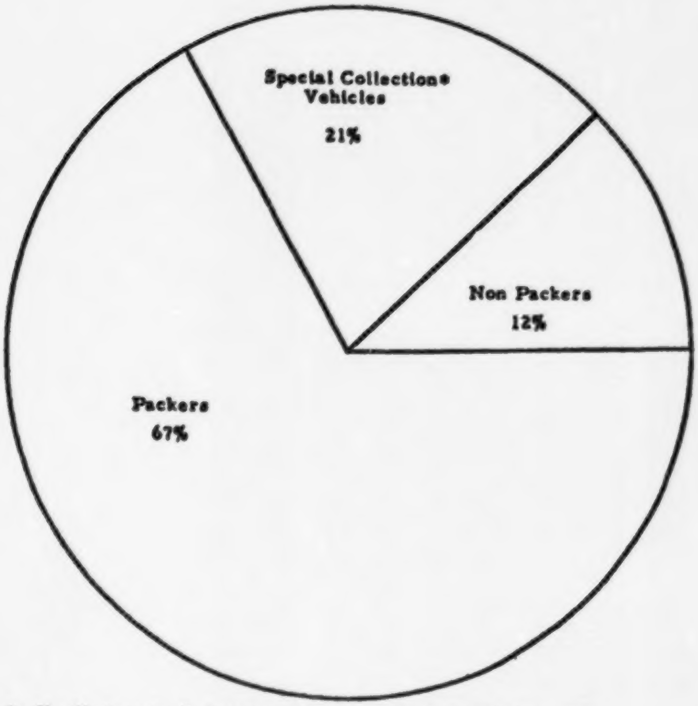
NATIONAL ESTIMATE OF TOTAL TRUCKS
OPERATED BY THE PRIVATE SECTOR

| Type of Truck | Number of Trucks | Percent of Total Trucks | Percent of each Type of Truck | Mean Capacity in Cubic Yards | Mean Crew Size | Cubic Yards Per Crew Member |
|---|---|---|---|---|---|---|
| Total Trucks | 61,648 | 100% | | | 1.59 | |
| Packers | 41,602 | 67.5% | 100.0% | | | |
| Rear Loaders | 26,230 | 42.5% | 63.0 | 20.18 | 1.99 | 10.14 |
| Front Loaders | 7,670 | 12.4% | 18.4 | 31.30 | 1.19 | 26.30 |
| Side Loaders | 7,702 | 12.5% | 18.6 | 21.02 | 1.81 | 11.61 |
| Non Packers | 7,327 | 11.9% | 100.0% | | | |
| Open | 7,244 | 11.8% | 98.8 | | 1.32 | 11.33 |
| Side-Loaders | 83 | 0.1% | 1.2 | | 1.50 | 0.77 |
| Special Collection Vehicles | 12,736 | 20.7% | 100% | | | |
| Roll-off Chassis | 6,496 | 10.5% | 51.0 | | | |
| Hoist Type Vehicle | 2,206 | 3.6% | 17.3 | | | |
| Other Collection Vehicles * | 4,034 | 6.6% | 31.7 | | | |

* Other Collection Vehicles include satellite vehicles

Front and side loaders each constitute approximately 12% of the total trucks, but primarily serve different types of customers. The side loader is more highly associated with residential collection, and the front loader with commercial collection.

Roll-off chassis are dominant in the category of special collection vehicles. It should be noted that the category "Other" collection vehicles includes satellite vehicles.



*roll-off chassis, hoist type vehicles, satellite vehicles, etc.

Figure 5.1: FLEET COMPOSITION OF AVERAGE CONTRACTOR

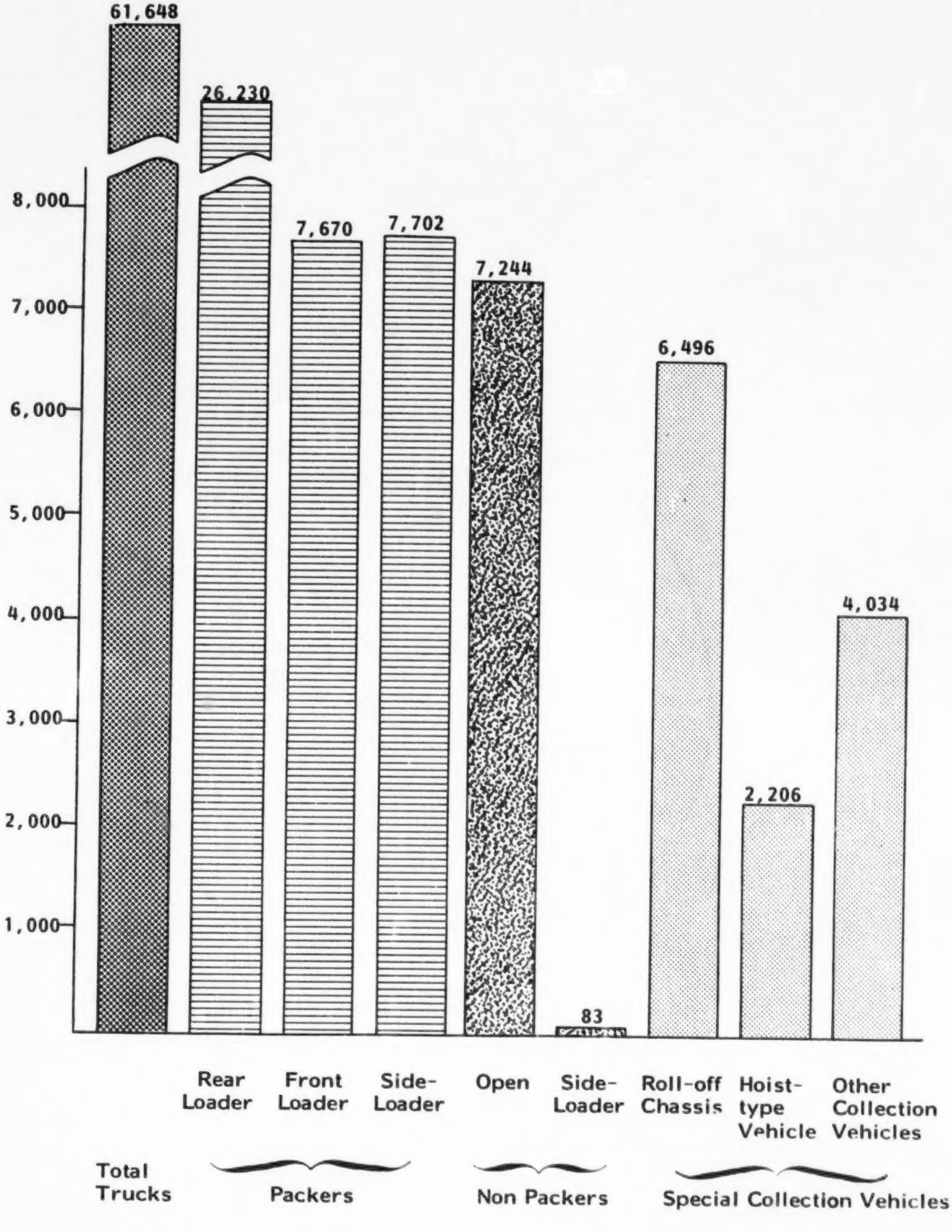


FIGURE 5.2: DISTRIBUTION OF TOTAL TRUCKS AMONG TRUCK TYPES

Cubic yard capacity among packer trucks shows little difference between rear and side loader vehicles. Front loaders, however, are approximately 50 percent larger than other packers. This factor, combined with a reduced crew size requirement in front loader trucks, creates a highly efficient collection vehicle in terms of equipment and manpower usage (Table 5.1).

The national estimates of daily truck utilization indicate that, on any given day, 77.5 percent of a contractor's total trucks will be on the job collecting, 19.0 percent will be held in reserve, and 3.6 percent will be out for maintenance. Our investigation reveals that a significant proportion of the reserve fleet are most probably open trucks and are, in fact, used on call only. Trucks of this nature are often used for the collection of special or bulky items and, as such, do not necessarily service daily routes. Given this is valid we can conclude that the 77.5 percent is a conservative reflection of daily truck utilization.

TABLE 5.2

NATIONAL ESTIMATE OF TRUCK UTILIZATION PER DAY IN PRIVATE SECTOR

| | Number of Trucks | Percent of Trucks |
|---|---|---|
| Total Trucks | 61,648 | 100% |
| Trucks Collecting Today | 47,721 | 77.5% |
| Trucks Held in Reserve | 11,691 | 19.0% |
| Trucks Out for Maintenance | 2,231 | 3.6% |

Note: Numbers do not always add to total due to rounding error in forecasting national figures.

The difference in truck utilization is relatively small across most variables. Points of interest include the observation of a high daily utilization by one truck operators (91%) and lower utilization by operators of 2-5 trucks (Table 5.3). This utilization level should be moderated by the consideration of a general industry practice to maintain at least one extra vehicle in order to always be able to serve the customer. It bears repeating that the reserve truck represents a significant proportion of the total available fleet and reduces the reported utilization. Also, the common practice in modernizing equipment is to replace a non-packer with a packer, and retain the non-packer as a reserve vehicle.

Utilization of trucks reaches a peak among contractors who collect 20-39 percent of their total tonnage from residential customers (Table 5.4). This condition is a result of this group's size in terms of tonnage and trucks as measured by the average number of trucks per contractor (10.48) (Table 5.4).

### TABLE 5.3

### UTILIZATION OF TRUCKS IN PRIVATE SECTOR BY SIZE OF CONTRACTOR

| | Size of Contractor | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 truck | 2-3 trucks | 4-5 trucks | 6-9 trucks | 10-19 trucks | 20-49 trucks | 50 or more trucks | Total |
| Total Contractors | 2,608 | 3,193 | 1,421 | 1,261 | 982 | 405 | 157 | 10,027 |
| Mean Number of Total Trucks | 1.00 | 2.40 | 4.42 | 7.17 | 13.31 | 27.59 | 82.75 | 6.15 |
| Mean Number of Trucks Collecting Today | 0.91 | 1.63 | 2.97 | 5.15 | 10.47 | 22.49 | 69.50 | 4.76 |
| Percent of Total Trucks Collecting on Average Day | 91.0% | 67.9% | 67.2% | 71.8% | 78.7% | 81.5% | 84.0% | 77.5% |

### TABLE 5.4

### UTILIZATION OF TRUCKS IN PRIVATE SECTOR BY MIX OF COLLECTION

| | % Residential Collection | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 100% | 80-99% | 60-79% | 40-59% | 20-39% | 1-19% | 100%* | Total |
| Total Contractors | 375 | 1,835 | 1,402 | 1,081 | 661 | 522 | 4,143 | 10,027 |
| Mean Number of Total Trucks | 3.62 | 6.59 | 7.58 | 8.18 | 10.48 | 4.35 | 5.14 | 6.15 |
| Mean Number of Trucks Collecting Today | 2.68 | 4.85 | 5.89 | 6.44 | 8.58 | 3.27 | 4.00 | 4.76 |
| Percent of Total Trucks Collecting on Average Day | 74.0% | 73.6% | 77.7% | 78.7% | 81.9% | 75.2% | 77.8% | 77.5% |

* Commercial and Industrial

## TABLE 5.5

## UTILIZATION OF TRUCKS IN PRIVATE SECTOR BY SMSA SIZE

| | SMSA Size | | | | | | |
|---|---|---|---|---|---|---|---|
| | over 1,000,000 | 500,000-1,000,000 | 250,000-499,999 | 100,000-249,999 | 50,000-99,999 | Non SMSA | Total |
| **Total Contractors** | 4,456 | 1,311 | 1,498 | 1,017 | 149 | 1,596 | 10,027 |
| **Mean Number of Total Trucks** | 8.30 | 6.51 | 4.25 | 5.01 | 5.27 | 3.57 | 6.15 |
| **Mean Number of Trucks Collecting Today** | 6.60 | 5.10 | 3.23 | 3.56 | 4.00 | 2.47 | 4.76 |
| **Percent of Total Trucks Collecting On an Average Day** | 79.5% | 78.3% | 76.0% | 71.1% | 75.9% | 69.2% | 77.5% |

## MANPOWER ANALYSIS

Nationally, the private sector employs 102,000 persons. This represents 10.2 employees per contractor. However, two-thirds of all private sector employees work for only 15 percent of the contractors. Collection employees (those out driving and helping on any given day) account for about three-fourths of the total work force.

TABLE 5.6

NATIONAL ESTIMATE OF MANPOWER EMPLOYED BY PRIVATE SECTOR

| | Total Number | Percent |
|---|---|---|
| Total Employees | 102,388 | 100% |
| Employees Collecting Today | 75,460 | 73.7 |
| Mean Crew Size for all Collection Vehicles | 1.59 | |
| Mean Number Days Worked Per Week | 5.78 | |

A key consideration in examining the number of collection employees is the contractor's mix of collection. As the contractor's tonnage (and therefore his customers) tend to become more commercial and industrial, his net number of men per truck reduces (Table 5.7). This condition is, of course, a function of the equipment required in servicing commercial and industrial accounts. As previously noted, front loaders are used almost exclusively in collecting commercial and industrial customers, and have the smallest average crew size. Furthermore, commercial and industrial collection often necessitates the use of other specialized collection equipment such as roll-off chassis.

In servicing commercial and industrial customers the use of truck types which require small crew sizes combined with the use of on site containers results in a situation where a small work force is capable of collecting a large amount of waste.

Conversely, residential collection generally requires more men per truck (Table 5.7). Those operations that are totally residential require on the average 2 men crews. The type of equipment used in residential collection also affects the average crew size. Both rear and side loader trucks predominate in residential collection, requiring more men for collection .

## TABLE 5.7

## ANALYSIS OF MANPOWER BY MIX OF COLLECTION IN PRIVATE SECTOR

| | % Residential Collection | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 100% | 80-99% | 60-79% | 40-59% | 20-39% | 1-19% | 100%* | Total |
| Total Contractors | 375 | 1,835 | 1,402 | 1,081 | 661 | 522 | 4,143 | 10,027 |
| Mean Number of Employees | 7.29 | 11.88 | 14.68 | 14.89 | 19.78 | 6.53 | 7.07 | 10.21 |
| Mean Number of Men Collecting Today | 5.59 | 9.69 | 11.41 | 10.59 | 14.71 | 4.31 | 4.65 | 7.53 |
| Percent of Total Employees Collecting on Average Day | 76.7% | 81.6% | 77.7% | 71.1% | 74.4% | 66.0% | 65.8% | 73.8% |
| Mean Number of Total Trucks Collecting Today | 2.68 | 4.85 | 5.89 | 6.44 | 8.58 | 3.27 | 4.00 | 4.76 |
| Mean Number of Men Collecting Per Truck | 2.09 | 2.00 | 1.94 | 1.64 | 1.71 | 1.32 | 1.16 | 1.59 |

* Commercial and Industrial

Since the largest contractors as measured by fleet size are the most heavily involved in residential collection, their fleet configuration tends to contain a high percentage of rear loaders. The larger crew size required on rear loaders results in a slight increase in the average crew size per truck as contractor size increases.

## TABLE 5.8

## ANALYSIS OF MANPOWER BY CONTRACTOR SIZE IN PRIVATE SECTOR

| | Size of Contractor | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 truck | 2-3 trucks | 4-5 trucks | 6-9 trucks | 10-19 trucks | 20-49 trucks | 50 or more trucks | Total |
| Total Contractors | 2,608 | 3,193 | 1,421 | 1,261 | 982 | 405 | 157 | 10,027 |
| Mean Number of Total Employees | 1.58 | 3.35 | 6.06 | 11.44 | 23.73 | 50.49 | 151.75 | 10.21 |
| Mean Number of Men Collecting Today | 1.31 | 2.44 | 4.49 | 8.00 | 16.29 | 35.93 | 124.56 | 7.53 |
| Percent of Total Employees Collecting On Average Day | 82.9 | 72.8 | 74.1% | 69.9 | 68.7% | 71.2% | 82.1% | 73.7% |
| Mean Number of Total Trucks Collecting Today | .91 | 1.63 | 2.97 | 5.15 | 10.47 | 22.49 | 69.50 | 4.76 |
| Mean Number of Men Collecting Per Truck | 1.44 | 1.50 | 1.51 | 1.55 | 1.56 | 1.59 | 1.79 | 1.59 |

The proportion of daily collection employees to all employees is highest in predominantly residential companies. Those companies are most often found among very large and very small contractors (Table 5.8). This high ratio of collection employees to total employees should, however, be expected. Generally, a residentially based company will employ more drivers and helpers to collect the same tonnage as a commercial company. Given a larger number of collection employees, the percent they comprise of total employees will be higher.

Both the size of a contractor and his residential/commercial mix have effects on the crew size per truck and the ratio of collection employees to total employees. Commercial contractors, who are generally in the mid-size range, have smaller crew sizes because of the type of equipment they operate. The smallest and largest contractors tend to have a higher proportion of employees involved in daily collection (Table 5.8).

### TABLE 5.9

### ANALYSIS OF MANPOWER IN PRIVATE SECTOR BY SMSA SIZE

| | SMSA Size | | | | | | |
|---|---|---|---|---|---|---|---|
| | over 1,000,000 | 500,000-1,000,000 | 250,000-499,999 | 100,000-249,999 | 50,000-99,999 | Non SMSA | Total |
| **Total Contractors** | 4,456 | 1,311 | 1,498 | 1,017 | 149 | 1,596 | 10,027 |
| **Mean Number of Total Employees** | 14.25 | 12.21 | 7.61 | 7.11 | 8.00 | 5.42 | 10.21 |
| **Mean Number of Employees Collecting Today** | 10.68 | 8.08 | 5.31 | 5.36 | 5.67 | 3.87 | 7.53 |
| **Percent of Total Employees Collecting on an Average Day** | 74.9 | 66.2 | 69.8 | 75.4 | 70.9% | 71.4% | 73.7% |
| **Mean Number of Total Trucks Collecting Today** | 6.60 | 5.10 | 3.23 | 3.56 | 4.00 | 2.47 | 4.76 |
| **Mean Number of Men Collecting per Truck** | 1.62 | 1.58 | 1.64 | 1.51 | 1.42 | 1.57 | 1.59 |

In terms of city size, the proportion of employees involved in daily collection is lowest in SMSA's of 5000,000 - 1,000,000. This is consistent with the finding that contractors in this group tend to have a heavy commercial and industrial collection mix (Table 3.15).

In summary, packers comprise two-thirds of the total trucks operated by the private sector, and rear loader compactors make up the single largest category of all trucks. Non-packers account for 12 percent of total trucks, and special collection vehicles 21 percent, with half of the special collection vehicles being roll-off chassis. Packers represent over 85 percent of all collection trucks exclusive of special collection vehicles.

The daily utilization of trucks indicates that slightly over three-fourths of a contractor's total fleet is collecting on an average day, and that approximately 2 out of ten trucks are held in reserve for special pick-ups, and less than 5% are "down" for maintenance. Daily truck utilization varies by contractor size with an increasing daily utilization of trucks as contractor size increases.

## TRUCK TYPES AND SIZE OF CONTRACTOR

The ownership pattern of the private solid waste fleet of 61,000 vehicles shows that 15 percent of the contractors (those operating 10 or more trucks) own 59 percent of the rear loaders and front loaders, 66 percent of the side loaders among packers, and similar proportions of specialized collection vehicles. Conversely, contractors with 3 trucks or less operate 16 percent of the trucks while constituting 58 percent of all collection companies. This relationship holds true for all types of trucks except non-packers. In the case of open non-packer trucks, small contractors with 1-3 trucks account for 41 percent of that type of truck operated by the private sector, and this percent tends to decrease as contractor size increases (Table 5.10).

TABLE 5.10

PERCENT DISTRIBUTION OF TRUCK TYPES BY CONTRACTOR SIZE IN PRIVATE SECTOR

| Type of Truck | Size of Contractor | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 truck | 2-3 trucks | 4-5 trucks | 6-9 trucks | 10-19 trucks | 20-49 trucks | 50 or more trucks | Total |
| Distribution of Total Contractors | 26.0% | 31.8% | 14.1% | 12.6% | 9.8% | 4.0% | 1.6% | 100% |
| Share of Total Trucks | 4.2 | 12.0 | 9.9 | 14.4 | 20.8 | 17.8 | 20.9 | 100 |
| Packers | | | | | | | | |
| Rear Loader | 3.5 | 13.0 | 11.4 | 12.8 | 20.2 | 13.2 | 25.9 | 100 |
| Front Loader | 3.7 | 10.3 | 7.8 | 18.7 | 26.8 | 18.6 | 14.1 | 100 |
| Side Loader | 2.9 | 9.0 | 7.5 | 13.8 | 26.3 | 29.9 | 10.6 | 100 |
| Non Packers | | | | | | | | |
| Open | 15.3 | 26.1 | 14.6 | 15.4 | 11.5 | 7.1 | 10.0 | 100 |
| Side Loader | 32.5 | -- | -- | 32.5 | 34.9 | -- | -- | 100 |
| Special Collection Vehicles | | | | | | | | |
| Roll-off Chassis | 0.8 | 6.6 | 7.3 | 18.4 | 20.9 | 28.9 | 17.1 | 100 |
| Hoist Type Vehicle | -- | 5.0 | 14.4 | 18.1 | 27.9 | 29.3 | 5.3 | 100 |
| Other Collection Vehicles * | -- | 1.7 | 2.1 | 6.6 | 14.9 | 18.2 | 56.4 | 100 |

* Other Collection Vehicles include satellite vehicles, container trains, etc.

Contractors with 50 or more trucks own the most rear loaders (6,803), contractors with 10-19 trucks own the most front loaders (2,052), and contractors with 20-49 trucks own the most side loaders (2,304) (Table 5.11). Special collection vehicles are most often owned by operators of 10-49 trucks.

TABLE 5.11

NATIONAL ESTIMATE OF TRUCK TYPES BY CONTRACTOR SIZE
IN PRIVATE SECTOR

| Type of Truck | Size of Contractor | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 truck | 2-3 trucks | 4-5 trucks | 6-9 trucks | 10-19 trucks | 20-49 trucks | 50 or more trucks | Total |
| Total Contractors | 2,608 | 3,193 | 1,421 | 1,261 | 982 | 405 | 157 | 10,027 |
| Total Trucks | 2,608 | 7,398 | 6,103 | 8,877 | 12,823 | 10,973 | 12,884 | 61,648 |
| Packers | | | | | | | | |
| Rear Loader | 907 | 3,410 | 2,990 | 3,356 | 5,296 | 3,467 | 6,803 | 26,230 |
| Front Loader | 282 | 792 | 598 | 1,438 | 2,052 | 1,426 | 1,081 | 7,670 |
| Side Loader | 227 | 695 | 574 | 1,065 | 2,026 | 2,304 | 810 | 7,702 |
| Non Packers | | | | | | | | |
| Open | 1,111 | 1,893 | 1,056 | 1,119 | 833 | 516 | 715 | 7,244 |
| Side Loader | 27 | -- | -- | 27 | 29 | -- | -- | 83 |
| Special Collection Vehicles | | | | | | | | |
| Roll-off Chassis | 55 | 429 | 476 | 1,198 | 1,359 | 1,876 | 1,102 | 6,496 |
| Hoist Type Vehicle | -- | 111 | 317 | 399 | 616 | 647 | 115 | 2,206 |
| Other Collection Vehicles * | -- | 67 | 85 | 266 | 603 | 735 | 2,274 | 4,034 |

* Other Collection Vehicles include satellite vehicles, container trains, etc.

Perhaps the most interesting approach to analysis of truck types in relation to total fleet size is through a study of the mix of trucks within contractor size categories. These data should be viewed in terms of truck types to total trucks, and packer trucks to total packers.

Packer trucks comprise over half of the total trucks owned by all sizes of contractors and almost three-fourths of the trucks owned by contractors with 10-19 trucks(Table 5.12). There is some variation among the different sizes of contractors in the distribution of the three types of packer trucks - rear loaders, front loaders, and side loaders. Rear loaders make up the largest share of packers for all company sizes, but this varies from 78.2 percent of all packers owned by contractors with 50 trucks or more, to 48.2 percent among contractors who own 20-49 trucks (Table 5.13). Side loaders comprise 32 percent of the total trucks

TABLE 5.12

PERCENT DISTRIBUTION OF TRUCK TYPES WITHIN CONTRACTOR SIZES IN PRIVATE SECTOR

| Type of Truck | Size of Contractor | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 truck | 2-3 trucks | 4-5 trucks | 6-9 trucks | 10-19 trucks | 20-49 trucks | 50 or more trucks | Total |
| Distribution of Total Contractors | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| Share of Total Trucks | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Packers | 54.3 | 66.2 | 68.2 | 66.0 | 73.1 | 65.6 | 67.5 | 67.5 |
| Rear Loader | 34.8 | 46.1 | 49.0 | 37.8 | 41.3 | 31.6 | 52.8 | 42.5 |
| Front Loader | 10.8 | 10.7 | 9.8 | 16.2 | 16.0 | 13.0 | 8.4 | 12.4 |
| Side Loader | 8.7 | 9.4 | 9.4 | 12.0 | 15.8 | 21.0 | 6.3 | 12.5 |
| Non Packers | 43.6 | 25.6 | 17.3 | 12.9 | 6.7 | 4.7 | 5.5 | 11.9 |
| Open | 42.6 | 25.6 | 17.3 | 12.6 | 6.5 | 4.7 | 5.5 | 11.8 |
| Side Loader | 1.0 | -- | -- | 0.3 | 0.2 | -- | -- | 0.1 |
| Special Collection Vehicles | 2.1 | 8.2 | 14.4 | 21.0 | 20.1 | 29.7 | 27.1 | 20.7 |
| Roll-off Chassis | 2.1 | 5.8 | 7.8 | 13.5 | 10.6 | 17.1 | 8.6 | 10.5 |
| Hoist Type Vehicle | -- | 1.5 | 5.2 | 4.5 | 4.8 | 5.9 | 0.9 | 3.6 |
| Other Collection Vehicles * | -- | 0.9 | 1.4 | 3.0 | 4.7 | 6.7 | 17.6 | 6.6 |

* Other Collection Vehicles include satellite vehicles, container trains, etc.

TABLE 5.13

PERCENT OF PACKER TRUCKS IN PRIVATE SECTOR BY CONTRACTOR SIZE

| Type of Truck | Size of Contractor | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 truck | 2-3 trucks | 4-5 trucks | 6-9 trucks | 10-19 trucks | 20-49 trucks | 50 or more trucks | Total |
| Total Packers | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| Rear Loader | 64.1 | 69.6 | 71.8 | 57.3 | 56.5 | 48.2 | 78.2 | 63.0 |
| Front Loader | 19.9 | 16.2 | 14.4 | 24.5 | 21.9 | 19.8 | 12.4 | 18.4 |
| Side Loader | 16.0 | 14.2 | 13.8 | 18.2 | 21.6 | 32.0 | 9.3 | 18.5 |

for companies with 20-49 trucks, which is a higher proportion of side-loaders than for any other contractor size. The share of front loaders operated is highest for contractors with 6-9 trucks (24.5%) and 10-19 trucks (21.9%).

There is a decided decrease in the share of non-packer trucks as the size of contractor increases. While non-packers account for 43 percent of the trucks operated by the smallest contractors, they drop to less than 10 percent of those operated by companies with 10 or more trucks.

The type of truck operated by a contractor is, to a large degree, a function of the type of waste collected. The high incidence of rear loaders among the largest contractors is characteristic of their residential customer tonnage. Some 52.5 percent of the tonnage collected by a typical 50 truck or more operator is residential. The rear loader was designed primarily to fulfill this collection requirement, although containerization has also increased the utilization in commercial collection. Where commercial and industrial tonnage is highest the incidence of front loaders and roll-off chassis is highest (Table 7.8). Gross tonnage capabilities are affected by equipment types, i.e., front loaders have a capacity of 50 percent greater than rear or side loaders.

Thus in addition to contractor size, the mix of equipment is a critical determinant of a contractor's real contribution to the collection process.

## TRUCK TYPE AND MIX OF COLLECTION

The data support the concept that the types of trucks a contractor operates are related to his mix of collection. However, an interesting anomaly occurs in the description of the exclusively commercial contractor. The 4,143 contractors who collect only commercial and industrial wastes operate 34 percent of the trucks in the industry (Table 5.16). This represents a disproportionately low share of trucks. The natural implication suggests that these contractors are small. However, total commercial collection, in fact, implies a high level of sophisticated equipment. Contractors who collect only commercial wastes collect the highest gross tonnage per employee per day and a mean number of tons per day per truck (18.1) about twice that of the exclusively residential contractor (10.9) (Table 3.9).

It should be noted that "commercial" collection in this study is defined as including apartments of five or more units. Therefore, those contractors who are reported as exclusively commercial also serve apartment residences. The significant difference is their ability to use containers, front loading equipment, and special collection equipment in maximizing tonnage collected.

Companies specializing exclusively in residential or commercial collection operate the lowest mean number of trucks. Total residential operations are, however, dominated by rear loaders and non-packers. Commercial operators are significantly more involved with front loaders and special collection equipment.

Contractors whose mix of collection includes 20-39 percent residential tonnage operate the most trucks and packers per contractor. This group also has the highest total tonnage (19.6) per truck per day, which suggests a highly efficient use of the packer truck.

As might be expected, the mean number of trucks owned by a contractor, across the entire universe, is directly related to the average number of tons he collects. While significant variances in terms of tons per truck occur by equipment type, one can conclude that on an industry basis, the more tons a contractor collects a day the more trucks he needs to service his business.

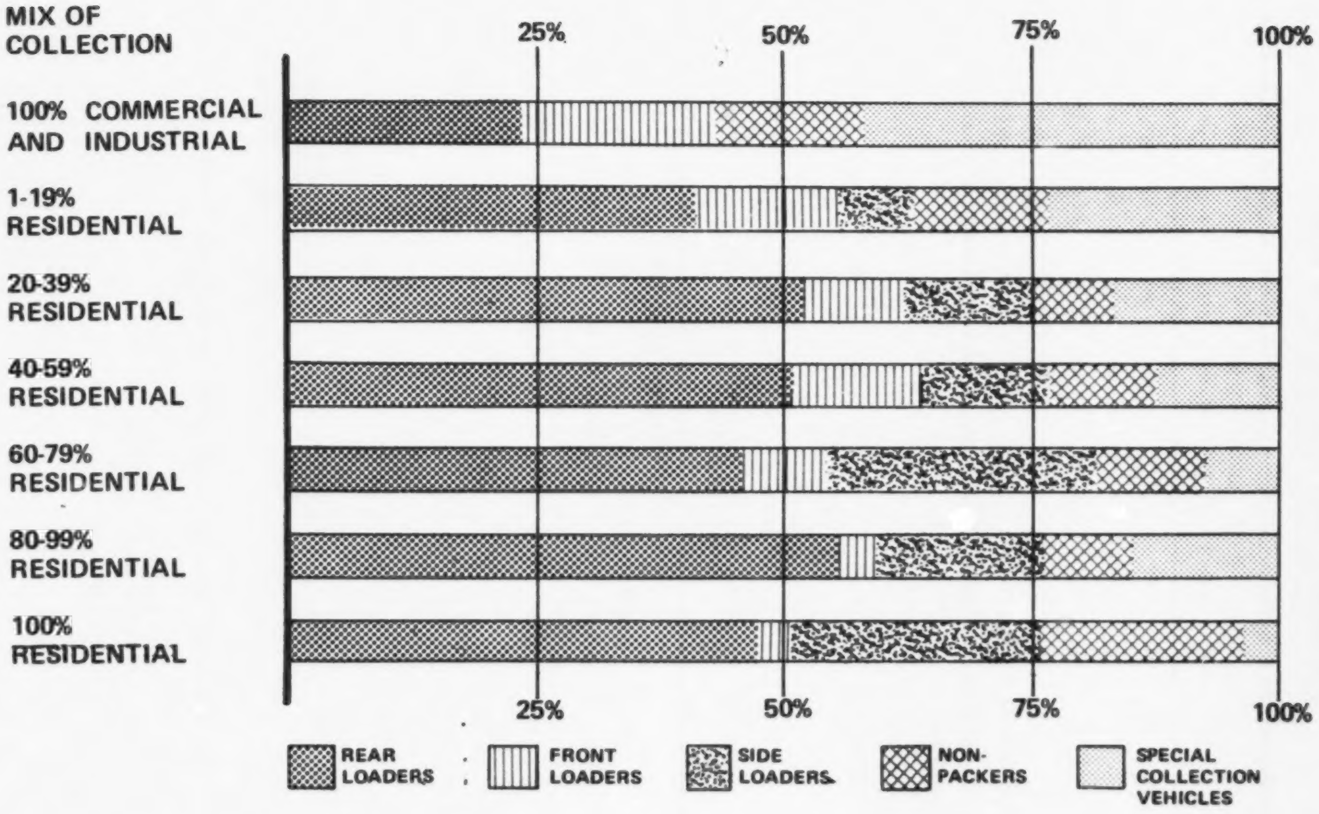


FIGURE 5.3: FLEET CONFIGURATION BY COLLECTION MIX

## TABLE 5.14

## MEAN NUMBER OF TRUCKS OPERATED BY PRIVATE SECTOR BY MIX OF COLLECTION

| Type of Truck | Mix of Collection | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 100% | 80-99% | 60-79% | 40-59% | 20-39% | 1-19% | 100%* | Total |
| Total Contractors | 375 | 1,835 | 1,402 | 1,081 | 661 | 522 | 4,143 | 10,027 |
| Total Trucks | 3.62 | 6.59 | 7.58 | 8.18 | 10.48 | 4.53 | 5.14 | 6.15 |
| Packers | 2.84 | 5.22 | 6.36 | 6.56 | 8.18 | 2.90 | 2.43 | 4.15 |
| Non Packers | 0.73 | 0.57 | 0.71 | 0.80 | 0.64 | 0.54 | 0.83 | 0.73 |
| Special Collection Vehicles | 0.05 | 0.81 | 0.51 | 0.82 | 1.68 | 0.90 | 1.88 | 1.27 |

* Commercial and Industrial

## TABLE 5.15

## NATIONAL ESTIMATE OF TRUCK TYPES BY MIX OF COLLECTION IN PRIVATE SECTOR

| Type of Truck | % Residential Collection | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 100% | 80-99% | 60-79% | 40-59% | 20-39% | 1-19% | 100%* | Total |
| Total Contractors | 375 | 1,835 | 1,402 | 1,081 | 661 | 522 | 4,143 | 10,027 |
| Total Trucks | 1,311 | 11,854 | 10,204 | 8,549 | 6,728 | 2,181 | 20,810 | 61,648 |
| Packers | | | | | | | | |
| Rear Loader | 630 | 6,767 | 4,853 | 4,459 | 3,594 | 918 | 4,984 | 26,230 |
| Front Loader | 54 | 521 | 890 | 1,174 | 675 | 414 | 3,942 | 7,670 |
| Side Loader | 339 | 1,972 | 2,757 | 1,163 | 924 | 100 | 447 | 7,702 |
| Non Packers | | | | | | | | |
| Open | 268 | 1,043 | 978 | 840 | 420 | 283 | 3,404 | 7,244 |
| Side Loader | -- | -- | 15 | 23 | -- | -- | 45 | 83 |
| Special Collection Vehicles | | | | | | | | |
| Roll-off Chassis | 20 | 689 | 461 | 494 | 747 | 234 | 3,852 | 6,496 |
| Hoist Type Vehicle | -- | 57 | 115 | 143 | 157 | 33 | 1,703 | 2,206 |
| Other Collection Vehicles ** | -- | 805 | 135 | 253 | 211 | 199 | 2,433*** | 4,034 |

* Commercial and Industrial

** Other Collection Vehicles include satellite vehicles, container trains, etc.

*** The high percentage of other collection vehicles among contractors collecting 100% commercial and industrial refuse is due to one contractor in the sample who operates over 100 special vehicles which inflated the national projection.

## TABLE 5.16

## PERCENT DISTRIBUTION OF TRUCK TYPES BY MIX OF COLLECTION IN PRIVATE SECTOR

| Type of Truck | % Residential Collection | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 100% | 80-99% | 60-79% | 40-59% | 20-39% | 1-19% | 100%* | Total |
| Distribution of Total Contractors | 3.7% | 18.3% | 14.0% | 10.8% | 6.6% | 5.2% | 41.3% | 100% |
| Share of Total Trucks | 2.1 | 19.2 | 16.6 | 13.9 | 10.9 | 3.5 | 33.8 | 100 |
| Packers | | | | | | | | |
| Rear Loader | 2.4 | 25.8 | 18.5 | 17.0 | 13.7 | 3.5 | 19.0 | 100 |
| Front Loader | 0.7 | 6.8 | 11.6 | 15.3 | 8.8 | 5.4 | 51.4 | 100 |
| Side Loader | 4.4 | 25.6 | 35.8 | 15.1 | 12.0 | 1.3 | 5.8 | 100 |
| Non Packers | | | | | | | | |
| Open | 3.7 | 14.4 | 13.5 | 11.6 | 5.8 | 3.9 | 47.0 | 100 |
| Side Loader | -- | -- | 18.2 | 28.1 | -- | -- | 53.8 | 100 |
| Special Collection Vehicles | | | | | | | | |
| Roll-off Chassis | 0.3 | 10.6 | 7.1 | 7.6 | 11.5 | 3.6 | 59.3 | 100 |
| Hoist Type Vehicle | -- | 2.6 | 5.2 | 6.5 | 7.1 | 1.5 | 77.2 | 100 |
| Other Collection Vehicles ** | -- | 20.0 | 3.3 | 6.3 | 5.2 | 4.9 | 60.3*** | 100 |

* Commercial and Industrial

** Other Collection Vehicles include satellite vehicles, container trains, etc.

*** The high percentage of other collection vehicles among contractors collecting 100% commercial and industrial refuse is due to one contractor who operates over 100 special vehicles which affects the national projection.

## TABLE 5.17

## PERCENT DISTRIBUTION OF TRUCK TYPES WITHIN COLLECTION MIX IN PRIVATE SECTOR

| Type of Truck | % Residential Collection | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 100% | 80-99% | 60-79% | 40-59% | 20-39% | 1-19% | 100%* | Total |
| Distribution of Total Contractors | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| Share of Total Trucks | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Packers | 78.1 | 78.1 | 83.3 | 79.5 | 77.1 | 65.7 | 45.0 | 67.5 |
| Rear Loader | 48.1 | 57.1 | 47.6 | 52.2 | 53.4 | 42.1 | 24.0 | 42.5 |
| Front Loader | 4.1 | 4.4 | 8.7 | 13.7 | 10.0 | 19.0 | 18.9 | 1.24 |
| Side Loader | 25.9 | 16.6 | 27.0 | 13.6 | 13.7 | 4.6 | 2.1 | 12.5 |
| Non Packers | 20.4 | 8.8 | 9.7 | 10.1 | 6.2 | 13.0 | 16.6 | 11.9 |
| Open | 20.4 | 8.8 | 9.6 | 9.8 | 6.2 | 13.0 | 16.4 | 11.8 |
| Side Loader | -- | -- | 0.1 | 0.3 | -- | -- | 0.2 | 0.1 |
| Special Collection Vehicles | 1.5 | 13.1 | 6.9 | 10.4 | 16.5 | 21.3 | 38.4 | 20.7 |
| Roll-off Chassis | 1.5 | 5.8 | 4.5 | 5.8 | 11.1 | 10.7 | 18.5 | 10.5 |
| Hoist Type Vehicle | -- | 0.5 | 1.1 | 1.7 | 2.3 | 1.5 | 8.2 | 3.6 |
| Other Collection Vehicles ** | -- | 6.8 | 1.3 | 2.9 | 3.1 | 9.1 | 11.7 | 6.6 |

*Commercial and Industrial

**Other Collection Vehicles include satellite vehicles, container trains, etc.

## TRUCK TYPE AND DAILY TONNAGE

The private sector collects 685,500 tons of all types of wastes daily using 61,600 trucks. Across all vehicles this equals 11.1 tons per truck per day, or typically, 5.5 tons per trip to the disposal site assuming an average of two trips per day. The statistics developed for this study do not allow a direct relationship between any given type of truck and the tonnage which it collects. However, general inferences may be drawn by the tonnage collected over the gross number of trucks and overall proportions of specific types operated.

In the context of tonnage collected, it appears as though contractors who collect 1000 tons or more daily require a heavy commitment to special collection vehicles, and on the average operate 62.5 trucks in total (Table 5.18). Among those contractors collecting 1000 tons or more, 68 percent of their total tonnage is commercial or industrial (Table 3.6).

TABLE 5.18

MEAN NUMBER OF TRUCK TYPES BY NUMBER OF TONS COLLECTED PER DAY IN PRIVATE SECTOR

| Type of Truck | Number of Tons Collected Per Day | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1-6 | 7-12 | 13-24 | 25-49 | 50-99 | 100-249 | 250-499 | 500-999 | 1000 or more | Total |
| Total Contractors | 2,636 | 1,726 | 1,865 | 1,238 | 1,099 | 918 | 277 | 161 | 110 | 10,027 |
| Mean Trucks | 1.6 | 2.1 | 3.6 | 5.2 | 8.9 | 13.6 | 24.7 | 37.3 | 62.5 | 6.2 |
| Packers | 0.7 | 1.5 | 2.6 | 3.8 | 5.9 | 9.6 | 16.7 | 30.1 | 40.3 | 4.2 |
| Non Packers | 0.8 | 0.5 | 0.6 | 0.6 | 0.8 | 0.6 | 1.1 | 1.9 | 1.5 | 0.7 |
| Special Collection Vehicles | 0.0 | 0.1 | 0.3 | 0.7 | 2.3 | 3.3 | 6.7 | 5.3 | 20.7 | 1.3 |

Analysis from another point of view shows that operators of 50 trucks or more average 83 trucks with 70 on the road daily, and collect only 779 tons per day (Figure 5.4). It should be noted, however, that 52.5 percent of the large contractors' waste is residential and therefore is less dense per cubic yard (Table 3.8). At the same time the contractor with 50 trucks or more operates a lower proportion of special collection vehicles than his 1000 tons or more a day counterpart.

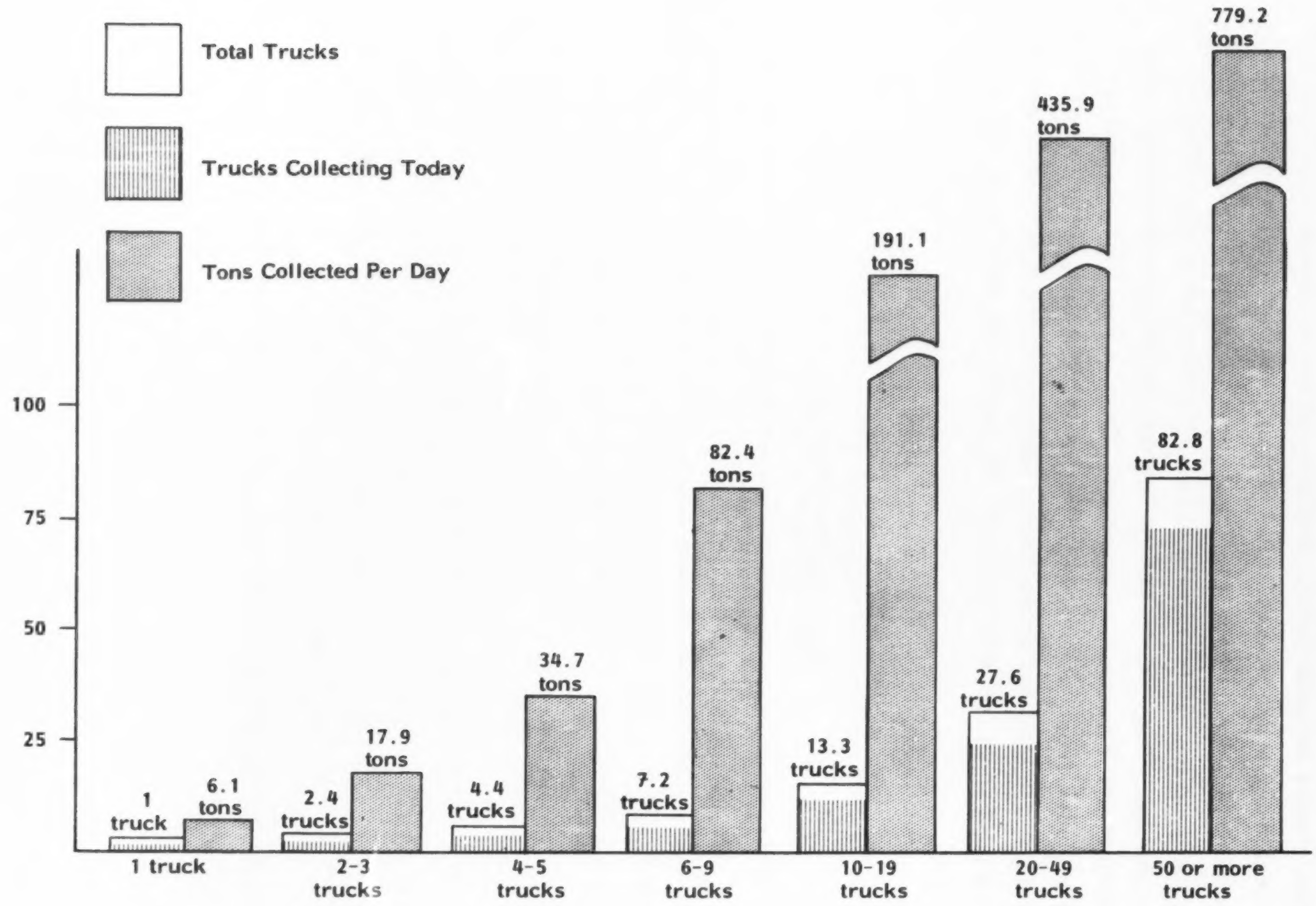


FIGURE 5.4: MEAN NUMBER OF TOTAL TRUCKS, TRUCKS COLLECTING TODAY AND DAILY TONNAGE BY CONTRACTOR SIZE

Packer trucks account for the majority of trucks owned by all contractors, except for those who collect 1-6 tons, and for these contractors, packers account for almost half (44.8%) of their total trucks. Among contractors who collect 500-999 tons daily, 79.6 percent of their fleet are packer trucks. They represent the highest proportion of packers operated by any particular contractor segment. Part of this high percentage of packers includes front loaders which make up 24.2 percent of the trucks owned by 500-999 ton contractors, and constitute more than twice the percentage of front loaders operated nationally (12.4%)(Table 5.20).

TABLE 5.19

NATIONAL ESTIMATE OF TRUCK TYPES
BY TONS COLLECTED IN PRIVATE SECTOR

| Type of Truck | Number of Tons Collected Per Day | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1-6 | 7-12 | 13-24 | 25-49 | 50-99 | 100-249 | 250-499 | 500-999 | 1000 or more | Total |
| Total Contractors | 2,636 | 1,726 | 1,865 | 1,238 | 1,099 | 918 | 277 | 161 | 110 | 10,027 |
| Total Trucks | 4,065 | 3,515 | 6,407 | 6,263 | 9,914 | 12,198 | 6,785 | 5,731 | 6,768 | 61,648 |
| Packers | | | | | | | | | | |
| Rear Loader | 1,259 | 1,548 | 3,279 | 2,990 | 3,803 | 4,538 | 2,707 | 2,597 | 3,489 | 26,230 |
| Front Loader | 184 | 598 | 606 | 606 | 1,074 | 2,002 | 706 | 1,388 | 506 | 7,670 |
| Side Loader | 377 | 308 | 739 | 963 | 1,363 | 1,902 | 1,140 | 578 | 331 | 7,702 |
| Non-Packers | | | | | | | | | | |
| Open | 2,137 | 855 | 1,166 | 761 | 898 | 594 | 340 | 319 | 167 | 7,244 |
| Side Loader | 30 | 19 | -- | -- | 13 | 21 | -- | -- | -- | 83 |
| Special Collection Vehicles | | | | | | | | | | |
| Roll-off Chassis | 26 | 84 | 201 | 409 | 682 | 1,884 | 896 | 702 | 1,618 | 6,496 |
| Hoist Type Vehicle | -- | 88 | 57 | 296 | 276 | 596 | 459 | 126 | 313 | 2,206 |
| Other Collection Vehicles* | 52 | 15 | 359 | 238 | 1,805 | 661 | 537 | 21 | 344 | 4,034 |

* Other Collection Vehicles include satellite vehicles, container trains, etc.

## TABLE 5.20

## PERCENT DISTRIBUTION OF TRUCK TYPES WITHIN TONS COLLECTED IN PRIVATE SECTOR

| Type of Truck | Number Tons Collected Per Day | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1-6 | 7-12 | 13-24 | 25-49 | 50-99 | 100-249 | 250-499 | 500-999 | 1000 or more | Total |
| Distribution of Total Contractors | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| Share of Total Trucks | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Packers | 44.8 | 69.8 | 72.2 | 72.8 | 62.9 | 69.2 | 67.1 | 79.6 | 64.0 | 67.5 |
| Rear Loader | 31.0 | 44.0 | 51.2 | 47.7 | 38.4 | 37.2 | 39.9 | 45.3 | 51.6 | 42.5 |
| Front Loader | 4.5 | 17.0 | 9.5 | 9.7 | 10.8 | 16.4 | 10.4 | 24.2 | 7.5 | 12.4 |
| Side Loader | 9.3 | 8.8 | 11.5 | 15.4 | 13.7 | 15.6 | 16.8 | 10.1 | 4.9 | 12.5 |
| Non Packers | 53.3 | 24.8 | 18.2 | 12.2 | 9.2 | 5.1 | 5.0 | 5.6 | 2.5 | 11.9 |
| Open | 52.6 | 24.3 | 18.2 | 12.2 | 9.1 | 4.9 | 5.0 | 5.6 | 2.5 | 11.8 |
| Side Loader | 0.7 | 0.5 | -- | -- | 0.1 | 0.2 | -- | -- | -- | 0.1 |
| Special Collection Vehicles | 1.9 | 5.3 | 9.6 | 15.0 | 27.9 | 25.7 | 27.9 | 14.8 | 33.6 | 20.7 |
| Roll-off Chassis | 0.6 | 2.4 | 3.1 | 6.5 | 6.9 | 15.4 | 13.2 | 12.2 | 23.9 | 10.5 |
| Hoist Type Vehicle | -- | 2.5 | 0.9 | 4.7 | 2.8 | 4.9 | 6.8 | 2.2 | 4.6 | 3.6 |
| Other Collection Vehicles * | 1.3 | 0.4 | 5.6 | 3.8 | 18.2 | 5.4 | 7.9 | 0.3 | 5.1 | 6.6 |

* Other Collection Vehicles include satellite vehicles, container trains, etc.

Contractors collecting 1000 tons or more own 2,275 special collection vehicles, and of these 1,618 are roll-off chasses. This constitutes one-fourth of the total roll-off chassis operated by the private sector. Roll-off chassis comprise 24.9 percent of the total trucks operated by contractors collecting 1000 tons or more which is more than twice the percent they comprise in the fleet composition of the contractors taken in total (10.5%).

Contractors collecting 100 tons or more operated a disproportionate share of trucks. Among total contractors, those who collect 100 or more tons per day make up 14.7 percent of all contractors, but operate 51.1 percent of the total trucks, and collect 74.7 percent of the total tonnage.

## TABLE 5.21

### PERCENT DISTRIBUTION OF TRUCK TYPES BY TONS COLLECTED IN PRIVATE SECTOR

| Type of Truck | Number of Tons Collected Per Day | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1-6 | 7-12 | 13-24 | 25-49 | 50-99 | 100-249 | 250-499 | 500-999 | 1000 or more | Total |
| Distribution of Total Contractors | 26.3% | 17.2% | 18.6% | 12.3% | 11.0% | 9.2% | 2.8% | 1.6% | 1.1% | 100 |
| Share of Total Trucks | 6.5 | 5.7 | 10.4 | 10.2 | 16.1 | 19.8 | 11.0 | 9.3 | 11.0 | 100 |
| Packers | | | | | | | | | | |
| Rear Loader | 4.8 | 5.9 | 12.5 | 11.4 | 14.5 | 17.3 | 10.3 | 9.9 | 13.3 | 100 |
| Front Loader | 2.4 | 7.8 | 7.9 | 7.9 | 14.0 | 26.1 | 9.2 | 18.1 | 6.6 | 100 |
| Side Loader | 4.9 | 4.0 | 9.6 | 12.5 | 17.7 | 24.7 | 14.8 | 7.5 | 4.3 | 100 |
| Non Packers | | | | | | | | | | |
| Open | 29.5 | 11.8 | 16.1 | 10.5 | 12.4 | 8.2 | 4.7 | 4.4 | 2.3 | 100 |
| Side Loader | 35.6 | 23.4 | -- | -- | 15.3 | 25.7 | -- | -- | -- | 100 |
| Special Collection Vehicles | | | | | | | | | | |
| Roll-off Chassis | 0.4 | 1.3 | 3.1 | 6.3 | 10.5 | 29.0 | 13.8 | 10.8 | 24.9 | 100 |
| Hoist Type Vehicle | -- | 4.0 | 2.6 | 13.4 | 12.5 | 27.0 | 20.8 | 5.7 | 14.2 | 100 |
| Other Collection Vehicles* | 1.3 | 0.4 | 8.9 | 5.9 | 44.7 | 16.4 | 13.3 | 0.5 | 8.5 | 100 |

* Other Collection Vehicles include satellite vehicles, container trains, etc.

Tonnage is the determinant of the fleet size and configuration of the fleet in the private sector. Certainly more trucks are required to collect more tonnage. Truck type is usually dictated by the type of customers being served and the type of equipment appropriate to these customers. Within the limits of this guideline, truck type is a significant variable in allowing the contractor to maximize his load and, therefore, operating efficiency.

## REGIONAL AND CITY SIZE CHARACTERISTICS

Truck types tend to vary according to the region of the country and city size. The variance is due to the type of service provided by the private sector (residential, commercial, etc.), contractual conditions, and, of course, the types of waste collected.

TABLE 5.22

NATIONAL ESTIMATE OF TOTAL TRUCKS OPERATED BY PRIVATE SECTOR FOR EACH REGION

| Type of Truck | Region | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Northeast | North Atlantic | Mid-Atlantic | South Atlantic | Mid-West | North Central | South Central | Mountain | West | Total |
| Total Contractors | 529 | 2,024 | 644 | 373 | 2,401 | 1,603 | 507 | 391 | 1,555 | 10,027 |
| Total Trucks | 2,413 | 12,568 | 2,763 | 3,413 | 14,421 | 6,645 | 3,592 | 1,349 | 14,505 | 61,648 |
| Packers | | | | | | | | | | |
| Rear Loader | 932 | 6,086 | 1,123 | 1,412 | 6,892 | 3,144 | 604 | 874 | 5,163 | 26,230 |
| Front Loader | 387 | 742 | 211 | 327 | 1,134 | 155 | 708 | 75 | 3,931 | 7,670 |
| Side Loader | 119 | 997 | 691 | 497 | 1,035 | 310 | 1,162 | 42 | 2,850 | 7,702 |
| Non Packers | | | | | | | | | | |
| Open | 543 | 1,784 | 270 | 407 | 1,773 | 993 | 358 | 275 | 843 | 7,244 |
| Side Loader | -- | -- | 23 | 23 | 22 | -- | -- | -- | 15 | 83 |
| Special Collection Vehicles | | | | | | | | | | |
| Roll-off Chassis | 268 | 1,454 | 70 | 193 | 2,333 | 284 | 410 | 83 | 1,401 | 6,496 |
| Hoist Type Vehicle | 104 | 965 | 211 | 91 | 524 | 91 | 166 | --- | 54 | 2,206 |
| Other Collection Vehicles* | 60 | 540 | 164 | 463 | 708 | 1,668 | 184 | -- | 248 | 4,034 |

* Other Collection Vehicles include satellite vehicles, container trains, etc.

TABLE 5.23

NATIONAL ESTIMATE OF TRUCK TYPES BY SMSA SIZE IN PRIVATE SECTOR

| Type of Truck | SMSA Size | | | | | | |
|---|---|---|---|---|---|---|---|
| | over 1,000,000 | 500,000-1,000,000 | 250,000-499,999 | 100,000-249,999 | 50,000-99,999 | Non SMSA | Total |
| Total Contractors | 4,456 | 1,311 | 1,498 | 1,017 | 149 | 1,596 | 10,027 |
| Total Trucks | 35,942 | 8,226 | 6,137 | 5,028 | 775 | 5,571 | 61,648 |
| Packers | | | | | | | |
| Rear Loader | 15,895 | 2,675 | 2,623 | 1,993 | 262 | 2,780 | 26,230 |
| Front Loader | 4.962 | 928 | 867 | 514 | 115 | 291 | 7,670 |
| Side Loader | 3,574 | 1,949 | 855 | 655 | 146 | 531 | 7,702 |
| Non Packers | | | | | | | |
| Open | 3,339 | 1,021 | 891 | 717 | 80 | 1,195 | 7,244 |
| Side Loader | -- | -- | 17 | 24 | 23 | 19 | 83 |
| Special Collection Vehicles | | | | | | | |
| Roll-off Chassis | 4,554 | 656 | 448 | 351 | 58 | 429 | 6,496 |
| Hoist Type Vehicle | 966 | 432 | 263 | 324 | 42 | 181 | 2,206 |
| Other Collection Vehicles* | 2,652 | 565 | 173 | 450 | 49 | 145 | 4,034 |

* Other Collection Vehicles include satellite vehicles, container trains, etc.

The private contractor population is concentrated in large, high density, urban areas. As a result, two-thirds of the private sector vehicles are operated in three regions--the North Atlantic, Midwest, and West, which account for one half the national population. Concurrently, 71 percent of all trucks are in cities of over 500,000. Thus, while 31 percent of the U.S. population is located in non-SMSA's, only 16 percent of the private contractors, and 9 percent of the trucks are in non-SMSA's. The private contractors who are located in non-SMSA's tend to be smaller in terms of their average number of trucks, and are more dependent on open trucks.

### TABLE 5.24

### MEAN NUMBER OF TRUCK TYPES BY REGION IN PRIVATE SECTOR

| Type of Truck | Region | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Northeast | North Atlantic | Mid-Atlantic | South Atlantic | Mid-West | North Central | South Central | Mountain | West | Total |
| Total Contractors | 529 | 2,024 | 644 | 373 | 2,401 | 1,603 | 507 | 391 | 1,555 | 10,027 |
| Mean Trucks | 4.56 | 6.20 | 4.29 | 9.15 | 6.01 | 4.15 | 7.09 | 3.45 | 9.32 | 6.15 |
| Packers | 2.72 | 3.86 | 3.15 | 6.00 | 3.78 | 2.25 | 4.88 | 2.53 | 7.68 | 4.15 |
| Non Packers | 1.03 | 0.88 | 0.45 | 1.15 | 0.75 | 0.62 | 0.71 | 0.70 | 0.55 | 0.73 |
| Special Collection Vehicles | 0.81 | 1.46 | 0.69 | 2.00 | 1.48 | 1.28 | 1.50 | 0.22 | 1.09 | 1.27 |

### TABLE 5.25

### MEAN NUMBER OF TRUCK TYPES BY SMSA SIZE

| Type of Truck | SMSA Size | | | | | | |
|---|---|---|---|---|---|---|---|
| | over 1,000,000 | 500,000-1,000,000 | 250,000-499,999 | 100,000-249,999 | 50,000-99,999 | Non SMSA | Total |
| Total Contractors | 4,456 | 1,311 | 1,498 | 1,017 | 149 | 1,596 | 10,027 |
| Mean Trucks | 8.3 | 6.51 | 4.25 | 5.01 | 5.27 | 3.57 | 6.15 |
| Packers | 5.75 | 4.49 | 3.05 | 3.25 | 3.67 | 2.33 | 4.15 |
| Non Packers | 0.75 | 0.78 | 0.60 | 0.73 | 0.67 | 0.76 | 0.73 |
| Special Collection Vehicles | 1.8 | 1.24 | 0.60 | 1.03 | 0.93 | 0.48 | 1.27 |

In the western states a high level of franchising has resulted in the development of larger companies. Many cities, or smaller communities within SMSA's, are franchised in whole or part in this region and large truck fleets are required to serve them. Traditionally, the South Atlantic states have operated collection under municipal systems. As a result, it appears that relatively few companies have developed. Those companies that have been established have tended to grow through commercial and industrial collection to relatively substantial size.

Operation of specific truck types varies by region. Packers comprise the largest share of trucks in all regions (67.5%), and are highest in the West (82.3%). Rear loaders make up the largest share of all trucks (42.5%) that operate in every region except the South Central where side loaders account for 32 percent of the total trucks, front loaders 20 percent, and rear loaders 17 percent. The 3,931 front loaders operated in the West also account for half of the national total and 27 percent of the total fleet in that region.

TABLE 5.26

PERCENT DISTRIBUTION OF TRUCK TYPES WITHIN REGIONS IN PRIVATE SECTOR

| Type of Truck | Region | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Northeast | North Atlantic | Mid Atlantic | South Atlantic | Mid-West | North Central | South Central | Mountain | West | Total |
| Distribution of Total Contractors | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| Share of Total Trucks | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Packers | 59.6 | 62.2 | 73.2 | 65.6 | 62.9 | 54.3 | 68.9 | 73.5 | 82.3 | 67.5 |
| Rear Loader | 38.6 | 48.4 | 40.6 | 41.4 | 47.8 | 47.3 | 16.8 | 64.8 | 35.6 | 42.5 |
| Front Loader | 16.1 | 5.9 | 7.6 | 9.6 | 7.9 | 2.3 | 19.7 | 5.6 | 27.1 | 12.4 |
| Side Loader | 4.9 | 7.9 | 25.0 | 14.6 | 7.2 | 4.7 | 32.4 | 3.1 | 19.6 | 12.5 |
| Non Packers | 22.5 | 14.2 | 10.8 | 12.6 | 12.5 | 14.9 | 10.0 | 20.4 | 5.9 | 11.9 |
| Open | 22.5 | 14.2 | 10.0 | 11.9 | 12.3 | 14.9 | 10.0 | 20.4 | 5.8 | 11.8 |
| Side Loader | -- | -- | 0.8 | 0.7 | 0.2 | -- | -- | -- | 0.1 | 0.1 |
| Special Collection Vehicles | 17.9 | 23.6 | 16.0 | 21.9 | 24.7 | 30.8 | 21.1 | 6.2 | 11.8 | 20.7 |
| Roll-off Chassis | 11.1 | 11.6 | 2.5 | 5.6 | 16.2 | 4.3 | 11.4 | 6.2 | 9.7 | 10.5 |
| Hoist Type Vehicle | 4.3 | 7.7 | 7.6 | 2.7 | 3.6 | 1.4 | 4.6 | -- | 0.4 | 3.6 |
| Other Collection Vehicles* | 2.5 | 4.3 | 5.9 | 13.6 | 4.9 | 25.1** | 5.1 | -- | 1.7 | 6.6 |

* Other Collection Vehicles include satellite vehicles, container trains, etc.

** The high percentage of other collection vehicles in the North Central is due to the effect of one contractor operating over 100 satellite vehicles

## TABLE 5.27

## PERCENT DISTRIBUTION OF TRUCK TYPES WITHIN SMSA SIZE IN PRIVATE SECTION

| Type of Truck | SMSA Size | | | | | | |
|---|---|---|---|---|---|---|---|
| | over 1,000,000 | 500,000-1,000,000 | 250,000-499,999 | 100,000-249,999 | 50,000-99,999 | Non SMSA | Total |
| Distribution of Total Contractors | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| Share of Total Trucks | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Packers | 69.3 | 68.9 | 70.7 | 64.9 | 69.6 | 65.4 | 67.5 |
| Rear Loader | 43.3 | 31.5 | 42.7 | 39.3 | 32.8 | 49.4 | 42.5 |
| Front Loader | 15.5 | 12.6 | 14.1 | 11.7 | 16.5 | 5.9 | 12.4 |
| Side Loader | 10.5 | 24.8 | 13.9 | 13.9 | 20.3 | 10.1 | 12.5 |
| Non Packers | 9.0 | 12.0 | 14.8 | 14.5 | 12.6 | 21.4 | 11.9 |
| Open | 9.0 | 12.0 | 14.5 | 14.1 | 10.1 | 21.1 | 11.8 |
| Side Loader | -- | -- | 0.3 | 0.4 | 2.5 | 0.3 | 0.1 |
| Special Collection Vehicles | 21.7 | 19.0 | 14.4 | 20.5 | 17.8 | 13.2 | 20.7 |
| Roll-off Chassis | 12.8 | 8.0 | 7.3 | 7.1 | 7.6 | 7.9 | 10.5 |
| Hoist Type Vehicle | 2.5 | 4.9 | 4.3 | 6.1 | 5.1 | 3.1 | 3.6 |
| Other Collection Vehicles * | 6.4 | 6.1 | 2.8 | 7.3 | 5.1 | 2.2 | 6.6 |

* Other Collection Vehicles include satellite vehicles, container trains, etc.

Specialized collection vehicles, necessary in commercial and industrial collection, are primarily in the largest cities and in the North Atlantic, Mid-West, and Western states. About 65-70 percent of the roll-off chassis and hoist type vehicles are operated in these areas (Tables 5.28 and 5.29).

## TABLE 5.28

## PERCENT DISTRIBUTION OF TRUCK TYPES BY REGION IN PRIVATE SECTOR

| Type of Truck | Region | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Northeast | North Atlantic | Mid-Atlantic | South Atlantic | Mid-West | North Central | South Central | Mountain | West | Total |
| Distribution of Total Contractors | 5.3% | 20.2% | 6.4% | 3.7% | 23.9% | 16.0% | 5.1% | 3.9% | 15.5% | 100% |
| Share of Total Trucks | 3.9 | 20.4 | 4.5 | 5.5 | 23.4 | 10.8 | 5.8 | 2.2 | 23.5 | 100 |
| Packers | | | | | | | | | | |
| Rear Loader | 3.5 | 23.2 | 4.3 | 5.4 | 26.3 | 12.0 | 2.3 | 3.3 | 19.7 | 100 |
| Front Loader | 5.1 | 9.7 | 2.7 | 4.3 | 14.8 | 2.0 | 9.2 | 1.0 | 51.2 | 100 |
| Side Loader | 1.5 | 12.9 | 9.0 | 6.5 | 13.4 | 4.0 | 15.1 | .5 | 37.0 | 100 |
| Non Packers | | | | | | | | | | |
| Open | 7.5 | 24.6 | 3.7 | 5.6 | 24.5 | 13.7 | 4.9 | 4.0 | 11.6 | 100 |
| Side Loader | -- | -- | 28.1 | 27.1 | 26.2 | -- | -- | -- | 18.6 | 100 |
| Special Collection Vehicles | | | | | | | | | | |
| Roll-off Chasis | 4.1 | 22.4 | 1.2 | 3.0 | 25.9 | 4.4 | 6.2 | 1.3 | 21.5 | 100 |
| Hoist Type Vehicle | 4.7 | 43.8 | 9.6 | 4.1 | 23.8 | 4.1 | 7.5 | -- | 2.5 | 100 |
| Other Collection Vehicles* | 1.5 | 13.4 | 4.1 | 11.5 | 17.6 | 41.3** | 4.6 | -- | 6.1 | 100 |

* Other Collection Vehicles include satellite vehicles, container trains, etc.

** The high percentage of other collection vehicles in the North Central is due to the effect of one contractor operating over 100 satellite vehicles

## TABLE 5.29

## PERCENT DISTRIBUTION OF TRUCK TYPES BY SMSA SIZE IN PRIVATE SECTOR

| Type of Truck | SMSA Size | | | | | | |
|---|---|---|---|---|---|---|---|
| | over 1,000,000 | 500,000-1,000,000 | 250,000-499,999 | 100,000-249,999 | 50,000-99,999 | Non SMSA | Total |
| Distribution of Total Contractors | 44.5% | 13.1% | 14.9% | 10.1% | 1.5% | 15.9% | 100% |
| Distribution of Total Trucks | 58.3 | 13.3 | 9.9 | 8.2 | 1.2 | 9.0 | 100 |
| Packers | | | | | | | |
| Rear Loader | 60.6 | 10.2 | 10.0 | 7.6 | 1.0 | 10.6 | 100 |
| Front Loader | 64.7 | 12.1 | 11.3 | 6.7 | 1.5 | 3.8 | 100 |
| Side Loader | 46.4 | 25.3 | 11.1 | 8.5 | 1.9 | 6.9 | 100 |
| Non Packers | | | | | | | |
| Open | 46.1 | 14.1 | 12.3 | 9.9 | 1.1 | 16.5 | 100 |
| Side Loader | -- | -- | 21.1 | 28.7 | 27.7 | 22.6 | 100 |
| Special Collection Vehicles | | | | | | | |
| Roll-off Chassis | 70.1 | 10.1 | 6.9 | 5.4 | 0.9 | 6.6 | 100 |
| Hoist Type Vehicle | 43.8 | 19.6 | 11.9 | 14.7 | 1.9 | 8.2 | 100 |
| Other Collection Vehicles* | 65.7 | 14.0 | 4.3 | 11.2 | 1.2 | 3.6 | 100 |

* Other Collection Vehicles include satellite vehicles, container trains, etc.

## PACKER-NON PACKER USE TRENDS

Nationally, packers increased by 83 percent from 1965 to 1970 to a level of 41,600. During the same period, non-packers decreased from 8800 to 7300, or 16 percent. These parallel equipment patterns demonstrate vast changes in use of technology and capacity among private contractors during the late 1960's.

The trend data available from this survey indicates that those companies operating during the period grew by 55 percent in the total number of packer and non-packer trucks operated.

TABLE 5.30

NATIONAL ESTIMATE OF TRENDS IN OPERATION OF PACKER AND NON PACKER TRUCKS IN THE PRIVATE SECTOR

| | Type of Truck | | | | | |
|---|---|---|---|---|---|---|
| | Packers | | Non Packers | | Total Packers and Non Packers | |
| | Number | Percent | Number | Percent | Number | Percent |
| 1965 | 22,739 | 72.1% | 8,784 | 27.9% | 31,523 | 100% |
| 1968 | 31,843 | 79.4% | 8,308 | 20.7% | 40,151 | 100% |
| Percent Change 1965 to 1968 | +40.0% | | -5.4% | | +27.4% | |
| 1970 | 41,602 | 85.0% | 7,327 | 15.0% | 48,929 | 100% |
| Percent Change 1968 to 1970 | +30.6% | | -11.7% | | +21.9% | |
| Percent Change 1965 to 1970 | +83.0% | | -16.1% | | +55.2% | |

NOTE: This does not imply the entire industry grew at this rate. Some companies have gone out of business and they are not considered here. However, in terms of the absolute number of trucks, growth in truck count has been impressive.

Growth in packers has been fairly constant proportionately by region throughout the country, ranging from a low of a 40 percent increase in the North Central region to a 62 percent increase in the Mountain region.

TABLE 5.31

NATIONAL ESTIMATE OF TRENDS IN OPERATION OF PACKER AND NON PACKER TRUCKS BY REGION

| Type of Truck | | | | | Region | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Northeast | North Atlantic | Mid-Atlantic | South Atlantic | Mid-West | North Central | South Central | Mountain | West | Total |
| **Packers** | | | | | | | | | | |
| 1970 | 1,438 | 7,825 | 2,025 | 2,236 | 9,061 | 3,609 | 2,474 | 991 | 11,944 | 41,602 |
| 1968 | 1,207 | 6,534 | 1,244 | 1,549 | 6,954 | 2,840 | 1,802 | 690 | 9,024 | 31,843 |
| 1965 | 804 | 4,525 | 843 | 1,039 | 4,746 | 2,159 | 1,285 | 374 | 6,966 | 22,739 |
| **Non-Packers** | | | | | | | | | | |
| 1970 | 543 | 1,784 | 293 | 430 | 1,795 | 993 | 348 | 275 | 858 | 7,327 |
| 1968 | 580 | 2,157 | 281 | 476 | 1,916 | 1,024 | 253 | 275 | 1,346 | 8,308 |
| 1965 | 469 | 2,096 | 247 | 373 | 1,844 | 908 | 201 | 224 | 2,423 | 8,784 |
| **Total Packers and Non Packers** | | | | | | | | | | |
| 1970 | 1,981 | 9,609 | 2,318 | 2,666 | 10,856 | 4,602 | 2,832 | 1,266 | 12,802 | 48,929 |
| 1968 | 1,787 | 8,691 | 1,525 | 2,025 | 8,870 | 3,864 | 2,055 | 965 | 10,370 | 40,151 |
| 1965 | 1,273 | 6,619 | 1,090 | 1,412 | 6,590 | 3,067 | 1,486 | 598 | 9,389 | 31,523 |
| **Special Collection Vehicles** | | | | | | | | | | |
| 1970 | 430 | 2,959 | 445 | 747 | 3,565 | 2,043 | 760 | 83 | 1,703 | 12.736 |
| **Total Trucks** | | | | | | | | | | |
| 1970 | 2,413 | 12,568 | 2,763 | 3,413 | 14,421 | 6,645 | 3,592 | 1,349 | 14,405 | 61,648 |

The three principal regions having the preponderance of packer trucks operate essentially the same proportion of total packers today as they did five years ago.

The decrease in non-packers is deceptive. In fact, the number of non-packers has remained relatively constant in most regions of the country, and even increased in some. Virtually all of the decline in non-packers since 1965 can be attributed to the decrease of non-packers in the West.

## TABLE 5.32

### MEAN NUMBER OF PACKERS AND NON PACKERS IN 1970, 1968, AND 1965 BY SIZE OF CONTRACTOR

| Type of Truck | Size of Contractor | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 truck | 2-3 trucks | 4-5 trucks | 6-9 trucks | 10-19 trucks | 20-49 trucks | 50 or more trucks | Total |
| Packers | | | | | | | | |
| 1970 | 0.56 | 1.61 | 3.07 | 4.83 | 9.93 | 18.17 | 57.69 | 4.15 |
| 1968 | 0.48 | 1.31 | 2.14 | 3.77 | 7.97 | 14.07 | 40.06 | 3.18 |
| 1965 | 0.39 | 0.86 | 1.38 | 2.70 | 5.71 | 10.41 | 30.56 | 2.27 |
| Non Packers | | | | | | | | |
| 1970 | 0.42 | 0.60 | 0.75 | 0.90 | 0.87 | 1.22 | 4.75 | 0.73 |
| 1968 | 0.41 | 0.64 | 0.84 | 0.99 | 0.93 | 1.54 | 8.00 | 0.83 |
| 1965 | 0.41 | 0.59 | 0.79 | 0.87 | 0.93 | 1.56 | 15.44 | 0.88 |
| Total Packers and Non Packers | | | | | | | | |
| 1970 | 0.98 | 2.21 | 3.82 | 5.73 | 10.80 | 19.39 | 62.44 | 4.88 |
| 1968 | 0.88 | 1.95 | 2.98 | 4.76 | 8.90 | 15.61 | 48.06 | 4.00 |
| 1965 | 0.80 | 1.44 | 2.17 | 3.57 | 6.64 | 11.98 | 46.00 | 3.15 |
| Special Collection Vehicles | | | | | | | | |
| 1970 | 0.02 | 0.19 | 0.60 | 1.44 | 2.51 | 8.20 | 20.32 | 1.27 |
| Total Trucks | | | | | | | | |
| 1970 | 1.00 | 2.40 | 4.42 | 7.17 | 13.31 | 27.59 | 82.75 | 6.15 |

## TABLE 5.33

### MEAN NUMBER OF PACKERS AND NON PACKERS IN 1970, 1968, AND 1965 BY NUMBER OF TONS COLLECTED PER DAY

| Type of Truck | Number of Tons Collected Per Day | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1-6 | 7-12 | 13-24 | 25-49 | 50-99 | 100-249 | 250-599 | 500-999 | 1000 or more | Total |
| Packers | | | | | | | | | | |
| 1970 | 0.73 | 1.53 | 2.62 | 3.85 | 5.90 | 9.63 | 16.86 | 30.06 | 40.27 | 4.15 |
| 1968 | 0.57 | 1.19 | 2.07 | 2.84 | 4.35 | 7.84 | 14.54 | 25.75 | 19.64 | 3.18 |
| 1965 | 0.37 | 0.84 | 1.34 | 2.05 | 3.19 | 5.63 | 11.32 | 20.88 | 11.09 | 2.27 |
| Non Packers | | | | | | | | | | |
| 1970 | 0.80 | 0.48 | 0.60 | 0.58 | 0.78 | 0.63 | 1.14 | 1.88 | 1.45 | 0.73 |
| 1968 | 0.79 | 0.54 | 0.69 | 0.70 | 0.83 | 0.76 | 1.68 | 3.06 | 3.45 | 0.83 |
| 1965 | 0.73 | 0.54 | 0.56 | 0.57 | 0.79 | 1.01 | 1.82 | 4.00 | 13.45 | 0.88 |
| Total Packers and Non Packers | | | | | | | | | | |
| 1970 | 1.53 | 2.01 | 3.22 | 4.42 | 6.68 | 10.26 | 18.00 | 31.94 | 41.73 | 4.88 |
| 1968 | 1.36 | 1.72 | 2.75 | 3.54 | 5.17 | 8.60 | 16.21 | 28.81 | 23.09 | 4.00 |
| 1965 | 1.09 | 1.38 | 1.91 | 2.62 | 3.98 | 6.64 | 13.14 | 24.88 | 24.55 | 3.15 |
| Special Collection Vehicles | | | | | | | | | | |
| 1970 | 0.03 | 0.11 | 0.33 | 0.74 | 2.26 | 3.31 | 6.71 | 5.32 | 20.73 | 1.27 |
| Total Trucks | | | | | | | | | | |
| 1970 | 1.57 | 2.11 | 3.56 | 5.16 | 8.94 | 13.57 | 24.71 | 37.25 | 62.45 | 6.15 |

### TABLE 5.34

### MEAN NUMBER OF PACKERS AND NON PACKERS IN 1970, 1968, AND 1965 BY MIX OF COLLECTION

| Type of Truck | % Residential Collection | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 100% | 80-99% | 60-79% | 40-59% | 20-39% | 1-19% | 100%* | Total |
| **Packers** | | | | | | | | |
| 1970 | 2.84 | 5.22 | 6.36 | 6.56 | 8.18 | 2.90 | 2.43 | 4.15 |
| 1968 | 2.43 | 3.57 | 4.94 | 5.21 | 6.30 | 2.40 | 1.91 | 3.18 |
| 1965 | 2.03 | 2.89 | 3.21 | 3.79 | 4.59 | 1.42 | 1.34 | 2.27 |
| **Open Non Packers** | | | | | | | | |
| 1970 | 0.73 | 0.57 | 0.71 | 0.80 | 0.64 | 0.54 | 0.83 | 0.73 |
| 1968 | 0.70 | 0.73 | 0.99 | 0.82 | 0.65 | 0.58 | 0.91 | 0.83 |
| 1965 | 0.49 | 0.81 | 1.74 | 0.81 | 0.70 | 0.63 | 0.83 | 0.88 |
| **Total Packers and Non Packers** | | | | | | | | |
| 1970 | 3.57 | 5.79 | 7.07 | 7.36 | 8.82 | 3.44 | 3.26 | 4.88 |
| 1968 | 3.14 | 4.30 | 5.94 | 6.04 | 6.95 | 2.98 | 2.81 | 4.00 |
| 1965 | 2.51 | 3.69 | 4.95 | 4.59 | 5.29 | 2.06 | 2.16 | 3.15 |
| **Special Collection Vehicles** | | | | | | | | |
| 1970 | 0.05 | 0.81 | 0.51 | 0.82 | 1.68 | 0.90 | 1.88 | 1.27 |
| **Total Trucks** | | | | | | | | |
| 1970 | 3.62 | 6.59 | 7.58 | 8.18 | 10.48 | 4.53 | 5.14 | 6.15 |

* Commercial and Industrial

Ranking those contractors who increased their packer truck fleets at a rate above the national norm (83%) on selected characteristics, we include operation of:

| | % |
|---|---|
| 50 or more trucks | 89 |
| 4-5 trucks | 122 |
| 2-3 trucks | 87 |
| 1-9 percent residential tonnage | 104 |
| 60-79 percent residential tonnage | 98 |
| 1000 tons or more per day | 263 |
| 13-24 tons per day | 95 |
| 25-49 tons per day | 88 |
| 50-99 tons per day | 88 |

Clearly, the mechanization process in packer trucks reaches it highest level among contractors collecting 1000 or more tons per day and who collect 68 percent of their refuse from commercial and industrial sources (Table 3.6). This is probably correlated with growth in front end loaders and containerization. At the same time large fleets were adding packers, they were dropping non-packers. The information contained in Table 5.33 shows that the loss among non-packers is overwhelming among companies collecting 100 tons or more per day. The decrease in the average number of non-packers is greatest among the largest companies.

Supporting the decrease of non-packers among large companies is the parallel decrease in non-packers among contractors located in the larger cities.

TABLE 5.35

MEAN NUMBER OF PACKERS AND NON PACKERS IN 1970, 1968, AND 1965 BY SMSA SIZE

| Type of Truck | SMSA Size | | | | | | |
|---|---|---|---|---|---|---|---|
| | over 1,000,000 | 500,000-1,000,000 | 250,000-499,999 | 100,000-249,999 | 50,000-99,999 | Non SMSA | Total |
| **Packers** | | | | | | | |
| 1970 | 5.75 | 4.49 | 3.05 | 3.25 | 3.67 | 2.33 | 4.15 |
| 1968 | 4.51 | 3.47 | 2.19 | 2.48 | 2.80 | 1.60 | 3.18 |
| 1965 | 3.40 | 2.71 | 1.44 | 1.41 | 1.80 | 0.91 | 2.27 |
| **Non Packers** | | | | | | | |
| 1970 | 0.75 | 0.78 | 0.60 | 0.73 | 0.67 | 0.76 | 0.73 |
| 1968 | 0.92 | 0.92 | 0.70 | 0.67 | 0.87 | 0.78 | 0.83 |
| 1965 | 1.19 | 0.84 | 0.67 | 0.60 | 0.73 | 0.69 | 0.88 |
| **Total Packers and Non Packers** | | | | | | | |
| 1970 | 6.50 | 5.27 | 3.65 | 3.98 | 4.34 | 3.09 | 4.88 |
| 1968 | 5.43 | 4.39 | 2.89 | 3.15 | 3.67 | 2.38 | 4.00 |
| 1965 | 0.59 | 3.55 | 2.11 | 2.01 | 2.53 | 1.60 | 3.15 |
| **Special Collection Vehicles** | | | | | | | |
| 1970 | 1.80 | 1.24 | 0.60 | 1.03 | 0.93 | 0.48 | 1.27 |
| **Total Trucks** | | | | | | | |
| 1970 | 8.30 | 6.51 | 4.25 | 5.01 | 5.27 | 3.57 | 6.15 |

## SPECIALIZED EQUIPMENT

Beyond the typical vehicle operations, various kinds of containers play a major role in the contractor's operations. Basically, the container allows an increased volume of on-site storage prior to collection, and a limitation on the frequency of required collection. Containerization is more prevalent among large contractors in service to commercial customers. However, as will be explained later in this chapter, some containerization is used in exclusively residential conditions.

This study quantified private contractor services relating to four types of specialized equipment--roll-off bodies, stationary containers, specially designed stationary containers, and stationary compactors. Often these four types of equipment are used in combination with each other and therefore, do not represent completely distinct installations. Furthermore, some contractors may not own the specialized equipment which they account for, since the customer may be the owner. In this case, the contractor still services the equipment.

The private sector operates or services about 1.8 million stationary containers or 290 per contractor among those that service that type of equipment. It should be noted that 67.5 percent of all contractors operate packers which closely correlates to the 61 percent servicing stationary containers.

TABLE 5.36

NATIONAL ESTIMATE OF SPECIALIZED EQUIPMENT SERVICED BY THE PRIVATE SECTOR

| Type of Equipment | Total Number | Number of Contractors Who Service | Percent of Contractors Who Service | Mean Number Per Contractors |
|---|---|---|---|---|
| Roll-off Bodies | 109,151 | 2,084 | 20.8% | 52.4 |
| Roll-off Chassis | 6,496 | 2,084 | 20.8% | 3.1 |
| (Ratio of Bodies to Chassis) | 16.8 | | | |
| Stationary Containers | 1,783,876 | 6,156 | 61.4% | 289.8 |
| Specially Designed Stationary Containers * | 20,812 | 656 | 6.5% | 31.7 |
| Stationary Compactors | 20.479 | 1,713 | 17.1% | 12.0 |

* Includes sludge containers, acid containers, rubber or plastic lined containers, etc.

Stationary containers have a wide range of uses due to their range in size (from 1/2 yard up). They are used in large proportion by those contractors who are exclusively commercial and industrial. However, it is important to note the incidence of specialized containers in residential collection. An example of containerization in residential collection is the system currently in use in Dade County, Florida, where each household has a small container on wheels which is serviced at curbside.

Roll-off bodies are used by contractors of all sizes (in terms of truck count). The one-truck contractors depicted in the following table operate single roll-off chassis each of which on the average supports almost 13 roll-off bodies. The national total of 109,000 bodies represents 16.8 bodies per chassis. The wide variance in that relationship is best explained by the 39:1 ratio experienced by the largest contractors compared to the national norm. Large contractors service 41 percent of all roll-off bodies. This apparent high level of efficiency is probably due to the large contractor's ability to drop roll-off bodies for long periods of time between pickups to service construction sites, or to use for other industrial and commercial tasks.

TABLE 5.37

NATIONAL ESTIMATE OF SPECIAL EQUIPMENT BY CONTRACTOR SIZE IN PRIVATE SECTOR

| Type of Equipment | Size of Contractor | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 truck | 2-3 trucks | 4-5 trucks | 6-9 trucks | 10-19 trucks | 20-49 trucks | 50 or more trucks | Total |
| Total Contractors | 2,608 | 3,193 | 1,421 | 1,261 | 982 | 405 | 157 | 10,02 |
| Roll-off Bodies | 655 | 3,929 | 5,348 | 13,207 | 17,682 | 23,457 | 44,861 | 109,151 |
| Roll-off Chassis | 52 | 429 | 481 | 1,195 | 1,351 | 1,838 | 1,150 | 6,496 |
| (Ratio of Bodies to Chassis) | 12.6 | 9.2 | 11.1 | 11.1 | 13.1 | 12.8 | 39.0 | 16.8 |
| Stationary Containers | 42,813 | 164,117 | 165,900 | 217,633 | 488,782 | 394,237 | 310,394 | 1,783,876 |
| Special Designed Stationary Containers * | -- | 395 | 1,082 | 2,060 | 5,432 | 10,718 | 1,103 | 20,812 |
| Stationary Compactors | -- | 942 | 840 | 4,628 | 4,853 | 5,181 | 4,034 | 20,479 |
| Mean Number of Stationary Compactors | -- | 4.8 | 4.5 | 10.1 | 9.6 | 20.4 | 41.3 | 2.0 |

* Includes sludge containers, acid containers, rubber or plastic lined containers, etc.

## TABLE 5.38

### PERCENT DISTRIBUTION OF SPECIAL EQUIPMENT BY CONTRACTOR SIZE IN PRIVATE SECTOR

| Type of Equipment | Size of Contractor | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 truck | 2-3 trucks | 4-5 trucks | 6-9 trucks | 10-19 trucks | 20-49 trucks | 50 or more trucks | Total |
| Total Contractors | 26.0% | 31.8% | 14.1% | 12.6% | 9.8% | 4.0% | 1.6% | 100% |
| Roll-off Bodies | 0.6 | 3.6 | 4.9 | 12.1 | 16.2 | 21.5 | 41.1 | 100 |
| Roll-off Chassis | 0.8 | 6.6 | 7.4 | 18.4 | 20.8 | 28.3 | 17.7 | 100 |
| Stationary Containers | 2.4 | 9.2 | 9.3 | 12.2 | 27.4 | 22.1 | 17.4 | 100 |
| Specially Designed Stationary Containers * | -- | 1.9 | 5.2 | 9.9 | 26.1 | 51.5 | 5.3 | 100 |
| Stationary Compactors | -- | 4.6 | 4.1 | 22.6 | 23.7 | 25.3 | 19.7 | 100 |

* Includes sludge containers, acid containers, rubber or plastic lined containers, etc.

The ratio of roll-off bodies to chassis is lowest among commercial collectors. This coincides with the commercial operator being smaller (5.0 trucks on the average) than companies collecting a combination of wastes.

## TABLE 5.39

### NATIONAL ESTIMATE OF SPECIAL EQUIPMENT BY MIX OF COLLECTION IN PRIVATE SECTOR

| Type of Equipment | % Residential Collection | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 100% | 80-99% | 60-79% | 40-59% | 20-39% | 1-19% | 100%* | Total |
| Total Contractors | 375 | 1,835 | 1,402 | 1,081 | 661 | 522 | 4,143 | 10,027 |
| Roll-off Bodies | 218 | 31,326 | 12,225 | 12,225 | 11,024 | 2,292 | 39,731 | 109,151 |
| Roll-off Chassis | 20 | 689 | 461 | 494 | 747 | 234 | 3,852 | 6,496 |
| (Ratio of Bodies to Chassis) | 10.9 | 45.5 | 26.5 | 24.7 | 14.8 | 9.8 | 10.3 | 16.8 |
| Stationary Containers | 1,784 | 130,223 | 276,501 | 280,069 | 255,094 | 92,762 | 747,444 | 1,783,876 |
| Specially Designed Stationary Containers ** | -- | 125 | 10,260 | 1,165 | 812 | 749 | 7,680 | 20,812 |
| Stationary Compactors | -- | 1,270 | 694 | 1,454 | 3,113 | 704 | 13,250 | 20,479 |
| Mean Number of Stationary Compactors | -- | 0.7 | 0.5 | 1.3 | 4.7 | 1.3 | 3.2 | 2.0 |

* Commercial and Industrial

** Includes sludge containers, acid containers, rubber or plactic lined containers, etc.

Stationary compactors are concentrated among the large contractors (20-39% residential) and contractors who collect 100 percent commercial and industrial refuse. This type of equipment is generally mated with roll-off bodies. It is estimated that the private sector owns or services over 20,000 stationary compactors.

### TABLE 5.40

### PERCENT DISTRIBUTION OF SPECIAL EQUIPMENT BY MIX OF COLLECTION IN PRIVATE SECTOR

| Type of Equipment | % Residential Collection | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 100% | 80-99% | 60-79% | 40-59% | 20-39% | 1-19% | 100%* | Total |
| Total Contractors | 3.7% | 18.3% | 14.0% | 10.8% | 6.6% | 5.2% | 41.3% | 100% |
| Roll-off Bodies | 0.2 | 28.7 | 11.2 | 11.2 | 10.1 | 2.1 | 36.4 | 100 |
| Roll-off Chassis | 0.3 | 10.6 | 7.1 | 7.6 | 11.5 | 3.6 | 59.3 | 100 |
| Stationary Containers | 0.1 | 7.3 | 15.5 | 15.7 | 14.3 | 5.2 | 41.9 | 100 |
| Specially Designed Stationary Containers ** | -- | 0.6 | 49.3 | 5.6 | 3.9 | 3.6 | 36.9 | 100 |
| Stationary Compactors | -- | 6.2 | 3.4 | 7.1 | 15.2 | 3.4 | 64.7 | 100 |

* Commercial and Industrial

** Includes sludge containers, acid containers, rubber or plastic lined containers, etc.

### TABLE 5.41

### NATIONAL ESTIMATE OF SPECIAL EQUIPMENT BY SMSA SIZE IN PRIVATE SECTOR

| Type of Equipment | SMSA Size | | | | | | |
|---|---|---|---|---|---|---|---|
| | over 1,000,000 | 500,000-1,000,000 | 250,000-499,999 | 100,000-249,999 | 50,000-99,999 | Non SMSA | Total |
| Total Contractors | 4,456 | 1,311 | 1,498 | 1,017 | 149 | 1,596 | 10,027 |
| Roll-off Bodies | 86,120 | 10,042 | 6,767 | 2,401 | 546 | 3,165 | 109,151 |
| Roll-off Chassis | 4,554 | 656 | 448 | 351 | 58 | 429 | 6,496 |
| (Ratio of Bodies to Chassis) | 18.9 | 15.3 | 15.1 | 6.8 | 9.4 | 7.4 | 16.8 |
| Stationary Containers | 1,189,845 | 258,662 | 114,168 | 67,787 | 17,839 | 133,791 | 1,783,676 |
| Specially Designed Stationary Containers * | 6,244 | 12,466 | 187 | 749 | 645 | 520 | 20,812 |
| Stationary Compactors | 13.086 | 2,703 | 2,294 | 901 | 102 | 1,393 | 20,479 |
| Mean Number of Stationary Compactors | 15.4 | 10.3 | 10.7 | 5.5 | 2.0 | 8.4 | 2.0 |

* Includes sludge containers, acid containers, rubber or plastic lined containers, etc.

Virtually all of the specialized collection equipment is located in cities of over 250,000.

TABLE 5.42

PERCENT DISTRIBUTION OF SPECIAL EQUIPMENT BY SMSA SIZE IN PRIVATE SECTOR

| Type of Equipment | SMSA Size |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|
|  | over 1,000,000 | 500,000-1,000,000 | 250,000-499,999 | 100,000-249,999 | 50,000-99,999 | Non SMSA | Total |
| Total Contractors | 44.5% | 13.1% | 14.9% | 10.1% | 1.5% | 15.9% | 100% |
| Roll-off Bodies | 78.9 | 9.2 | 6.2 | 2.2 | 0.5 | 2.9 | 100 |
| Roll-off Chassis | 70.1 | 10.1 | 6.9 | 5.4 | 0.9 | 6.6 | 100 |
| Stationary Containers | 66.7 | 14.5 | 6.4 | 3.8 | 1.0 | 7.5 | 100 |
| Specially Designed Stationary Containers * | 30.0 | 59.9 | 0.9 | 3.6 | 3.1 | 2.5 | 100 |
| Stationary Compactors | 63.9 | 13.2 | 11.2 | 4.4 | 0.5 | 6.8 | 100 |

*Includes sludge containers, acid containers, rubber or plastic lined containers, etc.

# 6

## DIRECT CUSTOMER CONTRACTING AND GOVERNMENT FRANCHISING

This chapter describes the extent of direct customer contracting and government franchising* among private contractors. These two methods of service are discussed for both residential and commercial customers. Data on direct customer contracting and franchising are analyzed by contractor size, daily tonnage, mix of collection, SMSA and non-SMSA units, and region.

Tabular output for each variable includes:

- National estimates of the number of contractors engaged in direct customer contracting and government franchising and the number of customers served under each system.
- The percent distribution of contractors across categories for each variable.
- The percent distribution of customers across and within categories for each variable.

This chapter is structured into the following subsections:

- Chapter Summary
- Extent of Direct Customer Contracting and Franchising
- Contracting/Franchising and Contractor Size
- Contracting/Franchising and Daily Tonnage
- Contracting/Franchising and Mix of Collection
- Regional and City Size Characteristics

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* Government franchising in this context refers to franchises or contracts awarded private contractors by municipalities, county governments, etc.

## CHAPTER SUMMARY

The data illustrating the extent of direct customer contracting and government franchising show that approximately half of the residential customers are serviced under direct customer contract, while the great majority of commercial customers are serviced by direct contract.

The incidence of government franchising is limited to approximately one-third of the residential contractors, and less than 10 percent of the commercial contractors. Contractors with government franchises are, on the average, larger (as measured by number of trucks operated and daily tonnage), collect both residential and commercial customers, are located in SMSA's of over one million, and are located in the North Atlantic, Mid-Atlantic, South Central, and West regions.

## EXTENT OF CONTRACTING AND FRANCHISING

Nearly half of the residential customers collected by the private sector are served under direct contract arrangements. While residential customers are divided equally between direct contracting and franchising mechanisms, only 30 percent of the 5,883 contractors who collect from residential customers have government franchises. This indicates that while fewer contractors have franchises than contract direct, those contractors that do have franchises tend to be larger and collect from more customers. Those contractors who service residential customers under government franchises collect, on the average, 7,068 customers, while the contractors who have direct contracts with residential customers collect an average of 2,534 customers(Table 6.1).

Commercial customers serviced under government franchises comprise a relatively minor segment (12.8%) of the total commercial customers.

TABLE 6.1

NATIONAL ESTIMATE OF CUSTOMERS SERVICED BY THE PRIVATE SECTOR UNDER DIRECT CONTRACT AND GOVERNMENT FRANCHISE

| Type of Collection | Number of Customers | Percent of Customers | Number of Contractors | Number of Customers Per Contractor |
|---|---|---|---|---|
| Residential Customers | | | | |
| Contract Direct | 12,432,149 | 50.3% | 4,906 | 2,534 |
| Government Franchise | 12,284,509* | 49.7% | 1,738 | 7,068 |
| Total Residential Customers | 24,716,758 | 100.0% | 5,883** | 4,201 |
| Commercial Customers | | | | |
| Contract Direct | 1,990,083 | 87.2% | 9,055 | 220 |
| Government Franchise | 285,445 | 12.8% | 741 | 385 |
| Total Commercial Customers | 2,275,528 | 100.0% | 9,651** | 236 |

* The original estimate of Government franchise customers was 11,717,509 or 47.4 percent of all residential customers. The 2.3 percent of residential customers unaccounted for was the result of some responding contractors counting a government franchise as one customer and reporting serving one customer under government franchise.

** The number of contractors who contract directly and have government franchises add to more than the total because some contractors operate under both direct contracting and government franchise systems.

## CONTRACTING/FRANCHISING AND CONTRACTOR SIZE

Large contractors account for a disproportionate share of the contractors servicing residential customers under government franchise. Of the 135 residential contractors operating 50 trucks or more, 74 percent have government franchises, while among the 1,347 residential one-truck contractors only 14 percent have government franchises (Table 6.2).

TABLE 6.2

NATIONAL ESTIMATE OF PRIVATE CONTRACTORS WHO CONTRACT DIRECT AND HAVE GOVERNMENT FRANCHISES BY CONTRACTOR SIZE

| Type of Collection | Size of Contractor | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 truck | 2-3 trucks | 4-5 trucks | 6-9 trucks | 10-19 trucks | 20-49 trucks | 50 or more trucks | Total |
| Total Contractors | 2,608 | 3,193 | 1,421 | 1,261 | 982 | 405 | 157 | 10,027 |
| Residential Contractors | | | | | | | | |
| Direct Contract | 1,217 | 1,629 | 795 | 554 | 495 | 123 | 93 | 4,906 |
| Government Franchise | 189 | 400 | 189 | 259 | 370 | 229 | 99 | 1,738 |
| Total Residential Contractors* | 1,347 | 1,865 | 894 | 671 | 682 | 288 | 135 | 5,883 |
| Commercial Contractors | | | | | | | | |
| Direct Contract | 2,246 | 3,006 | 1,349 | 1,177 | 860 | 281 | 145 | 9,055 |
| Government Franchise | 91 | 219 | 101 | 82 | 110 | 91 | 46 | 741 |
| Total Commercial Contractors* | 2,384** | 3,127 | 1,399 | 1,245 | 965 | 367 | 164 | 9,651 |

* The number of contractors who contract directly and have government franchises add to more than the total because some contractors operate under both direct contracting and government franchise systems.

** The number of contractors who contract directly and have government franchises do not add to 2,384 or more due to "No Answers".

Contractors who operate 5 or fewer trucks account for approximately 70 percent of the total contractors, but for only 45 percent of those with franchises to service residential customers. On the other hand, contractors who operate ten or more trucks comprise 15 percent of the total contractors and 50 percent of those with residential franchises.

A similar but less dramatic situation occurs with commercial franchises. Small contractors represent 56 percent of those contractors with commercial franchises, while large contractors account for 33 percent (Table 6.3).

TABLE 6.3

PERCENT DISTRIBUTION OF PRIVATE CONTRACTORS WHO CONTRACT DIRECT AND HAVE GOVERNMENT FRANCHISES BY CONTRACTOR SIZE

| Type of Collection | Size of Contractor | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 truck | 2-3 trucks | 4-5 trucks | 6-9 trucks | 10-19 trucks | 20-49 trucks | 50 or more trucks | Total |
| Distribution of Total Contractors | 26.0% | 31.8% | 14.1% | 12.6% | 9.8% | 4.0% | 1.6% | 100% |
| Residential Contractors | | | | | | | | |
| Direct Contract | 24.8 | 33.2 | 16.2 | 11.3 | 10.1 | 2.5 | 1.9 | 100 |
| Government Franchise | 10.9 | 23.0 | 10.9 | 14.9 | 21.3 | 13.2 | 5.7 | 100 |
| Total Residential Contractors | 22.9 | 31.7 | 15.2 | 11.4 | 11.6 | 4.9 | 2.3 | 100 |
| Commercial Contractors | | | | | | | | |
| Direct Contract | 24.8 | 33.2 | 14.9 | 13.0 | 9.5 | 3.1 | 1.6 | 100 |
| Government Franchise | 12.3 | 29.6 | 13.6 | 11.1 | 14.8 | 12.3 | 6.2 | 100 |
| Total Commercial Contractors | 24.7 | 32.4 | 14.5 | 12.9 | 10.0 | 3.8 | 1.7 | 100 |

The number of customers serviced under franchises is also related to contractor size. Over half of the total group of residential and commercial customers collected by private contractors under government franchises are serviced by contractors with 20 or more trucks. This exceeds the overall share (42%) of residential and commercial customers serviced by that group, illustrating the point that larger contractors are franchise-oriented (Table 6.5).

## TABLE 6.4

### NATIONAL ESTIMATE OF CUSTOMERS SERVICED BY THE PRIVATE SECTOR UNDER DIRECT CONTRACT AND GOVERNMENT FRANCHISE BY SIZE OF CONTRACTOR

| Type of Collection | Size of Contractor<br>1 truck | 2-3 trucks | 4-5 trucks | 6-9 trucks | 10-19 trucks | 20-49 trucks | 50 or more trucks | Total |
|---|---|---|---|---|---|---|---|---|
| Total Contractors | 2,608 | 3,193 | 1,421 | 1,261 | 982 | 405 | 157 | 10,027 |
| Total Customers* | 755,401 | 2,368,715 | 2,002,673 | 3,445,927 | 7,242,717 | 5,571,637 | 5,986,477 | 27,351,013 |
| Residential Customers | | | | | | | | |
| Direct Contract | 400,411 | 1,277,509 | 1,493,207 | 2,066,372 | 3,481,701 | 1,338,741 | 2,386,942 | 12,432,149 |
| Government Franchise | 266,941 | 816,768 | 305,837 | 1,064,512 | 3,219,798 | 3,810,264 | 2,803,463 | 12,284,609 |
| Total Residential Customers | 667,352 | 2,094,277 | 1,799,044 | 3,130,917 | 6,707,912 | 5,149,005 | 5,191,599 | 24,716,758 |
| Commercial Customers | | | | | | | | |
| Direct Contract | 67,663 | 228,860 | 171,147 | 243,895 | 394,036 | 250,750 | 632,846 | 1,990,083 |
| Government Franchise | 11,418 | 9,705 | 3,425 | 23,977 | 52,522 | 83,635 | 101,048 | 285,445 |
| Total Commercial Customers | 79,081 | 238,565 | 174,572 | 268,017 | 446,558 | 334,385 | 733,894 | 2,275,528 |

* Total Customers include industrial customers.

## TABLE 6.5

### PERCENT DISTRIBUTION OF CUSTOMERS SERVICED BY THE PRIVATE SECTOR UNDER DIRECT CONTRACT AND GOVERNMENT FRANCHISE BY SIZE OF CONTRACTOR

| Type of Collection | Size of Contractor<br>1 truck | 2-3 trucks | 4-5 trucks | 6-9 trucks | 10-19 trucks | 20-49 trucks | 50 or more trucks | Total |
|---|---|---|---|---|---|---|---|---|
| Distribution of Total Contractors | 26.0% | 31.8% | 14.1% | 12.6% | 9.8% | 4.0% | 1.6% | 100% |
| Share of Total Customers* | 2.7 | 8.6 | 7.3 | 12.6 | 26.5 | 20.4 | 21.9 | 100 |
| Residential Customers | | | | | | | | |
| Direct Contract | 3.2 | 10.3 | 12.0 | 16.6 | 28.0 | 10.8 | 19.2 | 100 |
| Government Franchise | 2.2 | 6.7 | 2.5 | 8.7 | 26.2 | 31.0 | 22.8 | 100 |
| Total Residential Customers | 2.7 | 8.5 | 7.3 | 12.7 | 27.1 | 20.8 | 21.0 | 100 |
| Commercial Customers | | | | | | | | |
| Direct Contract | 3.4 | 11.5 | 8.6 | 12.3 | 19.8 | 12.6 | 31.8 | 100 |
| Government Franchise | 4.0 | 3.4 | 1.2 | 8.4 | 18.4 | 29.3 | 35.4 | 100 |
| Total Commercial Customers | 3.5 | 10.5 | 7.7 | 11.8 | 19.6 | 14.7 | 32.3 | 100 |

* Total Customers include industrial customers.

An analysis of customers serviced under direct customer contract or government franchise as a function of the size of contractors shows that customers serviced under government franchises make up the largest share of total customers among contractors operating 20 or more trucks. Contractors operating 20-49 trucks collect 74 percent of their residential customers and 25 percent of their commercial customers under government franchises. Contractors operating 50 trucks or more service 54 percent of their residential customers and 14 percent of their commercial customers under a franchise (Table 6.6). Of all contractor size categories, only those contractors with 20-49 trucks collect more than half (71 percent) of their total customers under a franchise mechanism. These contractors are heavily concentrated in those regions and city size strata which have a high degree of franchising (Tables 6.20 and 6.23).

TABLE 6.6

PERCENT OF CUSTOMERS SERVICED BY THE PRIVATE SECTOR UNDER DIRECT CONTRACT AND GOVERNMENT FRANCHISE WITHIN CONTRACTOR SIZES

| Type of Collection | Size of Contractor | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 truck | 2-3 trucks | 4-5 trucks | 6-9 trucks | 10-19 trucks | 20-49 trucks | 50 or more trucks | Total |
| Residential Customers | | | | | | | | |
| Direct Contract | 60% | 61% | 83% | 66% | 52% | 26% | 46% | 50% |
| Government Franchise | 40 | 39 | 17 | 34 | 48 | 74 | 54 | 50 |
| Total Residential Contractors | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| Commercial Customers | | | | | | | | |
| Direct Contract | 86% | 96% | 98% | 91% | 88% | 75% | 86% | 87% |
| Government Franchise | 14 | 4 | 2 | 9 | 12 | 25 | 14 | 13 |
| Total Commercial Customers | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |

## CONTRACTING/FRANCHISING AND DAILY TONNAGE

The relationship of daily tonnage to the type of contracting mechanism follows the same pattern as that of contractor size. Contractors collecting a large number of tons per day are the most involved in franchise collection arrangements for both residential and commercial customers.

The number of contractors with franchises for residential customers is larger than the number contracting directly for those contractors collecting 250 tons per day or more. There are no tonnage categories in which contractors with government franchises for commercial customers outnumber those who contract directly. However, the percent of contractors with government franchises is greater among contractors collecting 50 tons or more per day than the percent they comprise of total commercial contractors (Table 6.8).

TABLE 6.7

NATIONAL ESTIMATE OF PRIVATE CONTRACTORS WHO CONTRACT DIRECT AND HAVE GOVERNMENT FRANCHISES BY TONNAGE

| Type of Collection | Number of Tons Collected Per Day | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1-6 | 7-12 | 13-24 | 25-49 | 50-99 | 100-249 | 250-499 | 500-999 | 1000 or more | Total |
| Total Contractors | 2,636 | 1,726 | 1,865 | 1,238 | 1,099 | 918 | 277 | 161 | 110 | 10,026 |
| Residential Contractors | | | | | | | | | | |
| Direct Contract | 1,452 | 824 | 981 | 687 | 461 | 324 | 74 | 74 | 29 | 4,906 |
| Government Franchise | 99 | 149 | 389 | 229 | 280 | 320 | 139 | 90 | 40 | 1,738 |
| Total Residential Contractors | 1,524 | 930 | 1,177 | 782 | 624 | 488 | 176 | 118 | 65 | 5,883 |
| Commercial Contractors | | | | | | | | | | |
| Direct Contract | 2,381 | 1,585 | 1,666 | 1,150 | 1,005 | 815 | 217 | 154 | 81 | 9,055 |
| Government Franchise | 27 | 110 | 183 | 73 | 119 | 128 | 46 | 46 | 9 | 741 |
| Total Commercial Customers* | 2,463** | 1,671 | 1,806 | 1,207 | 1,072 | 908 | 270** | 164 | 97** | 9,651 |

*The number of contractors who contract directly and have government franchises add to more than the total because some contractors operate under both direct contracting and government franchising systems.

**The number of contractors who contract directly and have government franchises do not add to the total or more than the total due to "No answers".

## TABLE 6.8

## PERCENT DISTRIBUTION OF PRIVATE CONTRACTORS WHO CONTRACT DIRECT AND HAVE GOVERNMENT FRANCHISES BY TONNAGE

| Type of Collection | Number of Tons Collected Per Day | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1-6 | 7-12 | 13-24 | 25-49 | 50-99 | 100-249 | 250-499 | 500-999 | 1000 or more | Total |
| Distribution of Total Contractors | 26.3% | 17.2% | 18.6% | 12.3% | 11.0% | 9.2% | 2.8% | 1.6% | 1.1% | 100% |
| Residential Contractors | | | | | | | | | | |
| Direct Contract | 29.6 | 16.8 | 20.0 | 14.0 | 9.4 | 6.6 | 1.5 | 1.5 | 0.6 | 100 |
| Government | 5.7 | 8.6 | 22.4 | 13.2 | 16.1 | 18.4 | 8.0 | 5.2 | 2.3 | 100 |
| Total Residential Customers | 25.9 | 15.8 | 20.0 | 13.3 | 10.6 | 8.3 | 3.0 | 2.0 | 1.1 | 100 |
| Commercial Contractors | | | | | | | | | | |
| Direct Contract | 26.3 | 17.5 | 18.4 | 12.7 | 11.1 | 9.0 | 2.4 | 1.7 | 0.9 | 100 |
| Government Franchise | 3.6 | 14.8 | 24.7 | 9.9 | 16.1 | 17.3 | 6.2 | 6.2 | 1.2 | 100 |
| Total Commercial Customers | 25.5 | 17.3 | 18.7 | 12.5 | 11.1 | 9.4 | 2.8 | 1.7 | 1.0 | 100 |

The share of residential customers serviced under a franchise is highest among contractors collecting over 100 tons per day. These contractors comprise only 15 percent of the total contractors, but collect three-fourths of the total residential customers serviced under a government franchise. Similarly, for commercial customers, contractors collecting more than 100 tons per day collected 87 percent of the commercial customers serviced under government franchises (Table 6.10).

## TABLE 6.9

## NATIONAL ESTIMATE OF CUSTOMERS SERVICED BY THE PRIVATE SECTOR UNDER DIRECT CONTRACT AND GOVERNMENT FRANCHISE BY TONNAGE

| Type of Collection | Number of Tons Collected Per Day | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1-6 | 7-12 | 13-24 | 25-49 | 50-99 | 100-249 | 250-499 | 500-999 | 1000 or more | Total |
| Total Contractors | 2,636 | 1,726 | 1,865 | 1,238 | 1,099 | 918 | 277 | 161 | 110 | 10,02 |
| Total Customers* | 169,175 | 968,062 | 2,581,993 | 2,806,308 | 3,816,289 | 6,741,707 | 3,794,637 | 3,887,672 | 2,604,842 | 27,351,01 |
| **Residential Customers** | | | | | | | | | | |
| Direct Contract | 79,871 | 667,210 | 1,437,529 | 1,871,749 | 2,230,482 | 3,127,300 | 795,762 | 1,232,226 | 1,002,409 | 12,432,14 |
| Government Franchise | 17,532 | 177,360 | 903,724 | 727,902 | 1,309,965 | 3,089,996 | 2,775,761 | 2,248,638 | 1,043,323 | 12,284,60 |
| Total Residential Customers | 97,404 | 844,570 | 2,341,253 | 2,599,651 | 3,540,447 | 6,217,296 | 3,571,523 | 3,480,864 | 2,045,732 | 24,716,75 |
| **Commercial Customers** | | | | | | | | | | |
| Direct Contract | 65,673 | 101,494 | 200,998 | 173,137 | 218,909 | 334,334 | 137,316 | 276,622 | 479,610 | 1,990,08 |
| Government Franchise | -- | 5,138 | 14,272 | 10,561 | 5,994 | 102,189 | 41,675 | 99,335 | 6,280 | 285,44 |
| Total Commercial Customers* | 65,673 | 106,632 | 215,270 | 183,698 | 224,903 | 436,523 | 178,991 | 375,957 | 485,890 | 2,275,52 |

* Total Customers include industrial customers.

## TABLE 6.10

## PERCENT DISTRIBUTION OF CUSTOMERS SERVICED BY THE PRIVATE SECTOR UNDER DIRECT CONTRACT AND GOVERNMENT FRANCHISE BY TONNAGE

| Type of Collection | Number of Tons Collected Per Day | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1-6 | 7-12 | 13-24 | 25-49 | 50-99 | 100-249 | 250-499 | 500-999 | 1000 or more | Total |
| Distribution of Total Contractors | 26.3% | 17.2% | 18.6% | 12.3% | 11.0% | 9.2% | 2.8% | 1.6% | 1.1% | 100% |
| Share of Total Customers* | 0.6 | 3.5 | 9.4 | 10.3 | 13.9 | 24.6 | 13.9 | 14.2 | 9.5 | 100 |
| **Residential Customers** | | | | | | | | | | |
| Direct Contract | 0.6 | 5.4 | 11.6 | 15.1 | 17.9 | 25.1 | 6.4 | 9.9 | 8.1 | 100 |
| Government Franchise | 0.1 | 1.4 | 7.4 | 5.9 | 10.7 | 25.2 | 22.6 | 18.3 | 8.5 | 100 |
| Total Residential Contractors | 0.4 | 3.4 | 9.5 | 10.5 | 14.3 | 25.2 | 14.4 | 14.1 | 8.3 | 100 |
| **Commercial Customers** | | | | | | | | | | |
| Direct Contract | 3.3 | 5.1 | 10.1 | 8.7 | 11.0 | 16.8 | 6.9 | 13.9 | 24.1 | 100 |
| Government Franchise | -- | 1.8 | 5.0 | 3.7 | 2.1 | 35.8 | 14.6 | 34.8 | 2.2 | 100 |
| Total Commercial Customers | 2.9 | 4.7 | 9.5 | 8.1 | 9.9 | 19.2 | 7.9 | 16.5 | 21.4 | 100 |

* Total Customers include industrial customers.

Both residential and commercial contractors collecting 100 tons or more collect a high percent of the customers serviced under government franchises (compared to their share of total customers) except for commercial contractors collecting 1000 tons or more. These contractors collect 21 percent of the total commercial customers but only 2 percent of the commercial customers serviced under government franchise (Table 6.11). This corresponds with the findings in Table 6.11 which show that among commercial contractors collecting 1000 tons or more, customers serviced under government franchise comprise only 1 percent of their total customers.

For residential contractors, those collecting 250-499 customers per day service a significantly higher percent of their total customers under a government franchise arrangement than did other contractors. Among commercial contractors, those collecting 100-999 tons per day have the highest percent of customers serviced under government franchise (over 20%). Of all contractor size groups, only those contractors who collect between 250-999 tons per day service more than half of their total customers under franchise arrangements (Table 6.9).

### TABLE 6.11

### PERCENT DISTRIBUTION OF CUSTOMERS SERVICED BY THE PRIVATE SECTOR UNDER DIRECT CONTRACT AND GOVERNMENT FRANCHISE BY TONNAGE

| Type of Collection | Number of Tons Collected Per Day | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1-6 | 7-12 | 13-24 | 25-49 | 50-99 | 100-249 | 250-499 | 500-999 | 1000 or more | Total |
| **Residential Customers** | | | | | | | | | | |
| Direct Contract | 82% | 79% | 61% | 72% | 63% | 50% | 22% | 35% | 49% | 50% |
| Government Franchise | 18 | 21 | 39 | 28 | 37 | 50 | 78 | 65 | 51 | 50 |
| Total Residential Customers | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| **Commercial Customers** | | | | | | | | | | |
| Direct Contract | 100% | 95% | 93% | 94% | 97% | 77% | 77% | 74% | 99% | 87% |
| Government Franchise | -- | 5 | 7 | 6 | 3 | 23 | 23 | 26 | 1 | 13 |
| Total Commercial Customers | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |

## CONTRACTING/FRANCHISING AND MIX OF COLLECTION

The number of residential contractors collecting under government franchises is lowest among the 522 contractors collecting 1-19 percent residential refuse. Among these contractors 90, or 17 percent, are involved in government franchising agreements, while among the other residential contractors, approximately 30 percent have government franchises (Table 6.12). Contractors with collection mixes of 60-99 percent residential comprise the largest share of total residential contractors (55.1%) and the largest share of residential contractors with government franchises (59.7%). For all other collection mix categories, the share of contractors with government franchises was the same or less than the contractor's share of total contractors (Table 6.13).

TABLE 6.12

NATIONAL ESTIMATE OF PRIVATE CONTRACTORS WHO CONTRACT DIRECT AND HAVE GOVERNMENT FRANCHISES BY MIX OF COLLECTION

| Type of Collection | % Residential Collection | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 100% | 80-99% | 60-79% | 40-50% | 20-39% | 1-19% | 100%* | Total |
| Total Contractors | 375 | 1,835 | 1,402 | 1,081 | 661 | 522 | 4,143 | 10,027 |
| Residential Contractors | | | | | | | | |
| Direct Contract | 299 | 1,487 | 1,217 | 917 | 579 | 412 | -- | 4,906 |
| Government Franchise | 109 | 619 | 419 | 320 | 179 | 90 | -- | 1,738 |
| Total Residential Contractors** | 375 | 1,835 | 1,402 | 1,081 | 661 | 522*** | -- | 5,883 |
| Commercial Contractors | | | | | | | | |
| Direct Contract | -- | 1,702 | 1,304 | 1,023 | 652 | 516 | 3,866 | 9,055 |
| Government Franchise | -- | 256 | 192 | 91 | 64 | 27 | 110 | 741 |
| Total Commercial Contractors** | -- | 1,835 | 1,402 | 1,081 | 661 | 522 | 4,143*** | 9,651 |

* Commercial and Industrial

** The number of contractors who contract directly and have government franchises add to more than the total because some contractors operate under both direct contracting and government franchise systems.

*** The number of contractors who contract direct and have government franchises do not add to the total or more than the total due to "No answers".

Among commercial contractors, the highest incidence of government franchise also occurs with those collecting 60-99 percent residential refuse. Of the 3,237 contractors in this category of collection mix, 448 or 14 percent have government franchises. The percent of commercial contractors with government franchises decreases as the collection mix becomes more heavily commercial and industrial. Only 110 of the 4,143 (3%) contractors who collect 100 percent commercial and industrial refuse service commercial customers under a government franchise.

The concentration of commercial franchises among contractors who are heavily residential (60-99%) indicates that these contractors service commercial customers under a franchise because the franchise covers combined residential and commercial collection. Thus, contractors with a heavy residential mix may tend to acquire some commercial customers because of the franchise.

### TABLE 6.13

### PERCENT DISTRIBUTION OF PRIVATE CONTRACTORS WHO CONTRACT DIRECT AND HAVE GOVERNMENT FRANCHISES BY MIX OF COLLECTION

| Type of Collection | % Residential Collection | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 100% | 80-99% | 60-79% | 40-50% | 20-39% | 1-19% | 100%* | Total |
| Distribution of Total Contractors | 3.7% | 18.3% | 14.0% | 10.8% | 6.6% | 5.2% | 41.3% | 100% |
| Residential Contractors | | | | | | | | |
| Direct Contract | 6.1 | 30.3 | 24.8 | 18.7 | 11.8 | 8.4 | -- | 100 |
| Government Franchise | 6.3 | 35.6 | 24.1 | 18.4 | 10.3 | 5.2 | -- | 100 |
| Total Residential Contractors | 6.3 | 31.2 | 23.9 | 18.4 | 11.3 | 8.9 | -- | 100 |
| Commercial Contractors | | | | | | | | |
| Direct Contract | -- | 18.8 | 14.4 | 11.3 | 7.2 | 5.7 | 42.7 | 100 |
| Government Franchise | -- | 34.6 | 25.9 | 12.3 | 8.6 | 3.7 | 14.8 | 100 |
| Total Commercial Contractors | -- | 19.0 | 14.5 | 11.2 | 6.9 | 5.4 | 43.0 | 100 |

* Commercial and Industrial

### TABLE 6.14

## NATIONAL ESTIMATE OF CUSTOMERS SERVICED BY THE PRIVATE SECTOR UNDER DIRECT CONTRACT AND GOVERNMENT FRANCHISE BY MIX OF COLLECTION

| Type of Collection | % Residential Collection | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 100% | 80-99% | 60-79% | 40-59% | 20-39% | 1-19% | 100%* | Total |
| Total Contractors | 375 | 1,835 | 1,402 | 1,081 | 661 | 522 | 4,143 | 10,027 |
| Total Customers** | 1,233,294 | 7,708,609 | 6,880,401 | 6,511,836 | 3,946,073 | 254,029 | 814,044 | 27,351,013 |
| Residential Customers | | | | | | | | |
| Direct Contract | 419,320 | 4,295,901 | 3,294,747 | 2,694,168 | 1,639,468 | 74,151 | -- | 12,432,149 |
| Government Franchise | 813,974 | 3,110,825 | 2,921,757 | 3,428,940 | 1,947,990 | 74,150 | -- | 12,284,609 |
| Total Residential Customers | 1,233,294 | 7,406,725 | 6,216,504 | 6,123,108 | 3,587,458 | 148,301 | -- | 24,716,758 |
| Commercial Customers | | | | | | | | |
| Direct Contract | -- | 218,909 | 585,084 | 222,889 | 256,721 | 83,583 | 622,896 | 1,990,083 |
| Government Franchise | -- | 73,931 | 46,528 | 126,738 | 23,692 | 4,567 | 9,991 | 285,445 |
| Total Commercial Customers | -- | 292,840 | 631,612 | 349,627 | 280,413 | 88,150 | 632,887 | 2,275,528 |

* Commercial and Industrial
** Total Customers include industrial customers.

### TABLE 6.15

## PERCENT DISTRIBUTION OF CUSTOMERS SERVICED BY THE PRIVATE SECTOR UNDER DIRECT CONTRACT AND GOVERNMENT FRANCHISE BY MIX OF COLLECTION

| Type of Collection | % Residential Collection | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 100% | 80-99% | 60-79% | 40-59% | 20-39% | 1-19% | 100%* | Total |
| Distribution of Total Contractors | 3.7% | 18.3% | 14.0% | 10.8% | 6.6% | 5.2% | 41.3% | 100% |
| Share of Total Customers** | 4.5 | 28.2 | 25.2 | 23.8 | 14.4 | 0.9 | 3.0 | 100 |
| Residential Customers | | | | | | | | |
| Direct Contract | 3.4 | 34.6 | 26.5 | 21.7 | 13.2 | 0.6 | -- | 100 |
| Government Franchise | 6.6 | 25.3 | 23.8 | 27.9 | 15.9 | 0.5 | -- | 100 |
| Total Residential Customers | 5.0 | 30.0 | 25.2 | 24.8 | 14.5 | 0.6 | -- | 100 |
| Commercial Customers | | | | | | | | |
| Direct Contract | -- | 11.0 | 29.4 | 11.2 | 12.9 | 4.2 | 31.3 | 100 |
| Government Franchise | -- | 25.9 | 16.3 | 44.4 | 8.3 | 1.6 | 3.5 | 100 |
| Total Commercial Customers | -- | 12.9 | 27.8 | 15.4 | 12.3 | 3.9 | 27.8 | 100 |

* Commercial and Industrial
** Total Customers include industrial customers.

## TABLE 6.16

### PERCENT OF CUSTOMERS SERVICED BY THE PRIVATE SECTOR UNDER DIRECT CONTRACT AND GOVERNMENT FRANCHISE WITHIN MIX OF COLLECTION CATEGORIES

| Type of Collection | % Residential Collection | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 100% | 80-99% | 60-79% | 40-59% | 20-39% | 1-19% | 100%* | Total |
| **Residential Customers** | | | | | | | | |
| Direct Contract | 34% | 58% | 53% | 44% | 45.7% | 50% | -- | 50% |
| Government Franchise | 66 | 42 | 47 | 56 | 54.3% | 50 | -- | 50 |
| Total Residential Customers | 100% | 100% | 100% | 100% | 100% | 100% | -- | 100% |
| **Commercial Customers** | | | | | | | | |
| Direct Contract | -- | 75% | 93% | 64% | 92% | 95% | 98% | 87% |
| Government Franchise | -- | 25 | 7 | 36 | 8 | 5 | 2 | 13 |
| Total Commercial Customers | -- | 100% | 100% | 100% | 100% | 100% | 100% | 100% |

* Commercial and Industrial

## REGIONAL AND CITY SIZE CHARACTERISTICS

Residential contractors with government franchises are heavily concentrated in SMSA's of over one million. Among the 1,853 residential contractors located in SMSA's of over one million, approximately half operate under government franchises. This is a significantly higher percent of contractors involved in government franchising than found in any other SMSA size (Table 6.17). The concentration of franchising among residential contractors in SMSA's of over one million is consistent with the finding that these contractors tend to be large (see Table 4.22), and are more likely to have a franchise.

The proportion of commercial contractors with franchises was fairly equal for all SMSA sizes.

TABLE 6.17

NATIONAL ESTIMATE OF PRIVATE CONTRACTORS WHO CONTRACT DIRECT AND HAVE GOVERNMENT FRANCHISES BY SMSA SIZE

| Type of Collection | SMSA Size | | | | | | |
|---|---|---|---|---|---|---|---|
| | over 1,000,000 | 500,000-1,000,000 | 250,000-499,999 | 100,000-249,999 | 50,000-99,999 | Non SMSA | Total |
| Total Contractors | 4,456 | 1,311 | 1,498 | 1,017 | 149 | 1,596 | 10,027 |
| Residential Contractors | | | | | | | |
| Direct Contract | 1,246 | 795 | 1,001 | 589 | 93 | 1,187 | 4,906 |
| Government Franchise | 909 | 200 | 259 | 99 | 10 | 259 | 1,738 |
| Total Residential Contractors* | 1,853 | 877 | 1,135 | 629 | 106** | 1,288 | 5,883 |
| Commercial Contractors | | | | | | | |
| Direct Contract | 4,020 | 1,222 | 1,295 | 924 | 145 | 1,458 | 9,055 |
| Government Franchise | 329 | 128 | 91 | 55 | 19 | 119 | 741 |
| Total Commercial Contractors* | 4,304 | 1,274 | 1,380 | 975 | 154 | 1,563 | 9,651 |

* The number of contractors who contract directly and have government franchises add to more than the total becuase some contractors operate under both direct contracting and government franchise systems.

** The number of contractors who contract directly and have government franchises do not add to the total or more than the total due to "No answers".

TABLE 6.18

PERCENT DISTRIBUTION OF PRIVATE CONTRACTORS WHO CONTRACT DIRECT AND HAVE GOVERNMENT FRANCHISES BY SMSA SIZE

| Type of Collection | SMSA Size over 1,000,000 | 500,000-1,000,000 | 250,000-499,999 | 100,000-249,999 | 50,000-99,999 | Non SMSA | Total |
|---|---|---|---|---|---|---|---|
| Distribution of Total Contractors | 44.5% | 13.1% | 14.9% | 10.1% | 1.5% | 15.9% | 100% |
| Residential Contractors | | | | | | | |
| Direct Contract | 25.4 | 16.2 | 20.4 | 12.0 | 1.9 | 24.2 | 100 |
| Government Franchise | 52.3 | 11.5 | 14.9 | 5.7 | 0.6 | 14.9 | 100 |
| Total Residential Contractors | 31.5 | 14.9 | 19.3 | 10.7 | 1.8 | 21.9 | 100 |
| Commercial Contractors | | | | | | | |
| Direct Contract | 44.4 | 13.5 | 14.3 | 10.2 | 1.6 | 16.1 | 100 |
| Government Franchise | 44.4 | 17.3 | 12.3 | 7.4 | 2.5 | 16.0 | 100 |
| Total Commercial Contractors | 44.6 | 13.2 | 14.3 | 10.1 | 1.6 | 16.2 | 100 |

Fifty-seven percent of the total residential customers are located in the largest SMSA's, while 64 percent of those who are serviced under government franchise are located in these SMSA's. SMSA's of 50,000 to 99,999, however, contain only 2 percent of the total commercial customers, but 10 percent of the commercial customers serviced under a franchise (Table 6.20). This disproportionately large share of commercial customers collected under franchises in the smallest SMSA's tends to indicate that, in the municipalities of this size, franchises include both residential and commercial collection.

This conclusion is supported by examining the percent of total customers serviced under direct contract or government franchise within SMSA sizes. Here we find that 68 percent of the residential customers and 70 percent of the commercial customers in SMSA's of 50,000-99,999 are serviced under franchises. This is a higher share than exists in any other SMSA size (Table 6.21). While a relatively small percent of contractors in these cities have franchises, those that do serve both the residential and commercial customers in an entire city.

## TABLE 6.19

## NATIONAL ESTIMATE OF CUSTOMERS SERVICES BY THE PRIVATE SECTOR UNDER DIRECT CONTRACT AND GOVERNMENT FRANCHISE BY SMSA SIZE

| Type of Collection | SMSA Size | | | | | | |
|---|---|---|---|---|---|---|---|
| | over 1,000,000 | 500,000-1,000,000 | 250,000-499,999 | 100,000-249,999 | 50,000-99,999 | Non-SMSA | Total |
| Total Contractors | 4,456 | 1,311 | 1,498 | 1,017 | 149 | 1,596 | 10,027 |
| Total Customers* | 15,848,467 | 3,775,501 | 2,610,534 | 2,523,331 | 284,188 | 2,286,415 | 27,351,013 |
| Residential Customers | | | | | | | |
| Direct Contract | 6,179,493 | 2,090,728 | 1,265,332 | 1,560,997 | 76,905 | 1,309,332 | 12,482,187 |
| Government Franchise | 7,864,809 | 1,336,695 | 1,167,999 | 840,537 | 163,423 | 837,114 | 12,210,577 |
| Total Residential Customers | 14,044,302 | 3,427,423 | 2,433,331 | 2,401,534 | 240,328 | 2,146,446 | 24,693,364 |
| Commercial Customers | | | | | | | |
| Direct Contract | 1,357,724 | 274,631 | 139,306 | 91,544 | 11,940 | 115,425 | 1,990,083 |
| Government Franchise | 192,104 | 17,127 | 18,839 | 17,698 | 27,974 | 11,989 | 285,445 |
| Total Commercial Customers | 1,549,828 | 291,758 | 158,145 | 109,242 | 39,914 | 127,414 | 2,275,528 |

* Total Customers include industrial customers.

## TABLE 6.20

## PERCENT DISTRIBUTION OF CUSTOMERS SERVICED BY THE PRIVATE SECTOR UNDER DIRECT CONTRACT AND GOVERNMENT FRANCHISE BY SMSA SIZE

| Type of Collection | SMSA Size | | | | | | |
|---|---|---|---|---|---|---|---|
| | over 1,000,000 | 500,000-1,000,000 | 250,000-499,999 | 100,000-249,999 | 50,000-99,999 | Non SMSA | Total |
| Distribution of Total Contractors | 44.5% | 13.1% | 14.9% | 10.1% | 1.5% | 15.9% | 100% |
| Share of Total Customers* | 58.0 | 13.8 | 9.5 | 9.2 | 1.0 | 8.4 | 100 |
| Residential Customers | | | | | | | |
| Direct Contract | 49.5 | 16.7 | 10.1 | 12.5 | 0.6 | 10.5 | 100 |
| Government Franchise | 64.4 | 10.9 | 9.6 | 6.9 | 1.3 | 6.9 | 100 |
| Total Residential Customers | 56.8 | 13.9 | 9.8 | 9.7 | 1.0 | 8.7 | 100 |
| Commercial Customers | | | | | | | |
| Direct Contract | 68.2 | 13.8 | 7.0 | 4.6 | 0.6 | 5.8 | 100 |
| Government Franchise | 67.3 | 6.0 | 6.6 | 6.2 | 9.8 | 4.2 | 100 |
| Total Commercial Customers | 68.1 | 12.8 | 7.0 | 4.8 | 1.8 | 5.6 | 100 |

* Total Customers include industrial customers.

TABLE 6.21

PERCENT OF CUSTOMERS SERVICED BY THE PRIVATE SECTOR UNDER DIRECT CONTRACT AND GOVERNMENT FRANCHISE WITHIN SMSA SIZES

| Type of Collection | SMSA Size | | | | | | |
|---|---|---|---|---|---|---|---|
| | over 1,000,000 | 500,000-1,000,000 | 250,000-499,999 | 100,000-249,999 | 50,000-99,999 | Non-SMSA | Total |
| Residential Customers | | | | | | | |
| Direct Contract | 44% | 61% | 52% | 65% | 32% | 61% | 50% |
| Government Franchise | 56 | 39 | 48 | 35 | 68 | 39 | 50 |
| Total Residential Customers | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| Commercial Customers | | | | | | | |
| Direct Contract | 88% | 94% | 88% | 84% | 30% | 91% | 87% |
| Government Franchise | 12 | 6 | 12 | 16 | 70 | 9 | 13 |
| Total Commercial Customers | 100% | 100% | 100% | 100% | 100% | 100% | 100% |

The North Atlantic, Mid-Atlantic, South Central, and West have the highest percent of residential contractors with government franchises. The Mid-Atlantic has the most with 375 contractors out of 559, or 67 percent, collecting under a government franchise. The West has the second highest percent of residential contractors involved in government franchising with 348 out of a total of 788 contractors (44%), followed by the North Atlantic (38%), and South Central (37%) (Table 6.22). The same regions also have a larger share of contractors with government franchises than would be expected on the basis of their share of total contractors (Table 6.23).

The Mid-Atlantic has the highest percent of contractors serving commercial customers under government franchises--157 out of 579 total contractors (27%)--and account for 21% of the total contractors with government franchises. While only 17 percent of the contractors in the West serve commercial customers under franchises, these contractors represent 35 percent of all contractors with commercial franchises (Table 6.23).

## TABLE 6.22

## NATIONAL ESTIMATE OF PRIVATE CONTRACTORS WHO CONTRACT DIRECT AND HAVE GOVERNMENT FRANCHISES BY REGION

| Type of Collection | Region | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Northeast | North Atlantic | Mid-Atlantic | South Atlantic | Mid-West | North Central | South Central | Mountain | West | Total |
| **Total Contractors** | 529 | 2,024 | 644 | 373 | 2,401 | 1,603 | 507 | 391 | 1,555 | 10,027 |
| **Residential Contractors** | | | | | | | | | | |
| Direct Contract | 270 | 648 | 235 | 285 | 1,482 | 1,060 | 167 | 206 | 559 | 4,906 |
| Government Franchise | 68 | 318 | 375 | 57 | 349 | 129 | 78 | 17 | 348 | 1,738 |
| Total Resident Contractors* | 312 | 830 | 559 | 288 | 1,547 | 1,130 | 212 | 218 | 788 | 5,883 |
| **Commercial Contractors** | | | | | | | | | | |
| Direct Contract | 453 | 1,874 | 570 | 353 | 2,182 | 1,512 | 462 | 380 | 1,259 | 9,055 |
| Government Franchise | 64 | 31 | 163 | 34 | 76 | 25 | 70 | 8 | 270 | 741 |
| Total Commercial Contractors* | 483 | 1,978** | 579 | 367 | 2,268** | 1,563** | 502 | 396** | 1,525** | 9,651 |

* The number of contractors who contract directly and have government franchises add to more than the total because some contractors operate under both direct contracting and government franchise systems.

** The number of contractors who contract directly and have government franchises do not add to the total or more than the total due to "No answers".

## TABLE 6.23

## PERCENT DISTRIBUTION OF PRIVATE CONTRACTORS WHO CONTRACT DIRECT AND HAVE GOVERNMENT FRANCHISES BY REGION

| Type of Collection | Region | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Northeast | North Atlantic | Mid-Atlantic | South Atlantic | Mid-West | North Central | South Central | Mountain | West | Total |
| Distribution of Total Contractors | 5.3% | 20.2% | 6.4% | 3.7% | 23.9% | 16.0% | 5.1% | 3.9% | 15.5% | 100% |
| **Residential Contractors** | | | | | | | | | | |
| Direct Contract | 5.5 | 13.2 | 4.8 | 5.8 | 30.2 | 21.6 | 3.4 | 4.2 | 11.4 | 100 |
| Government Franchise | 3.9 | 18.3 | 21.6 | 3.3 | 20.1 | 7.4 | 4.5 | 1.0 | 20.0 | 100 |
| Total Residential Contractors | 5.3 | 14.1 | 9.5 | 4.9 | 26.3 | 19.2 | 3.6 | 3.7 | 13.4 | 100 |
| **Commercial Contractors** | | | | | | | | | | |
| Direct Contract | 5.0 | 20.7 | 6.3 | 3.9 | 24.1 | 16.7 | 5.1 | 4.2 | 13.9 | 100 |
| Government Franchise | 8.7 | 4.2 | 22.2 | 4.6 | 10.2 | 3.4 | 9.4 | 1.1 | 36.4 | 100 |
| Total Commercial Contractors | 5.0 | 20.5 | 6.0 | 3.8 | 23.5 | 16.2 | 5.2 | 4.1 | 15.8 | 100 |

The same four regions--North Atlantic, Mid-Atlantic, South Central, and West--plus the Northeast, contain a larger share of residential customers serviced by government franchise than their share of total residential customers (Table 6.25). Within these five regions, the residential customers serviced by government franchise account for over half of the total customers, and in the South Central they comprise 84 percent of the total residential customers (Table 6.26).

The share of commercial customers serviced by government franchise are predominantly in the West (210,944 of the total 285,440 or 74 percent) with the second largest share being in the South Central (15%) (Table 6.25). Commercial customers serviced by government franchise also comprise a higher percent of the total customers within these regions than in other regions - 27 percent in the South Central and 22 percent in the West (Table 6.26).

TABLE 6.24

NATIONAL ESTIMATE OF CUSTOMERS SERVICED BY THE PRIVATE SECTOR UNDER DIRECT CONTRACT AND GOVERNMENT FRANCHISE BY REGION

| Type of Collection | Region | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Northeast | North Atlantic | Mid-Atlantic | South Atlantic | Mid-West | North Central | South Central | Mountain | West | Total |
| Total Contractors | 529 | 2,024 | 644 | 373 | 2,401 | 1,603 | 507 | 391 | 1,555 | 10,027 |
| Total Customers* | 1,422,169 | 4,555,760 | 1,778,464 | 1,726,018 | 6,165,367 | 1,820,021 | 1,281,752 | 583,230 | 8,040,140 | 27,351,013 |
| Residential Customers | | | | | | | | | | |
| Direct Contract | 400,534 | 1,146,473 | 526,631 | 1,060,476 | 4,081,326 | 1,378,206 | 177,538 | 472,309 | 3,207,792 | 12,432,149 |
| Government Franchise | 934,580 | 3,099,722 | 1,172,178 | 546,306 | 1,509,532 | 302,533 | 932,076 | 24,858 | 3,765,669 | 12,284,609 |
| Total Residential Customers | 1,335,114 | 4,246,195 | 1,698,809 | 1,606,782 | 5,590,858 | 1,680,739 | 1,109,614 | 497,167 | 6,973,462 | 24,716,758 |
| Commercial Customers | | | | | | | | | | |
| Direct Contract | 56,806 | 236,401 | 69,429 | 89,677 | 468,700 | 130,102 | 116,268 | 79,606 | 743,094 | 1,990,083 |
| Government Franchise | 5,138 | 2,854 | 6,280 | 13,416 | 2,854 | 571 | 43,673 | -- | 210,944 | 285,445 |
| Total Commercial Customers | 61,944 | 239,255 | 75,709 | 103,093 | 471,554 | 130,673 | 159,941 | 79,606 | 954,038 | 2,275,528 |

* Total Customers include industrial customers.

## TABLE 6.25

## PERCENT DISTRIBUTION OF CUSTOMERS SERVICED BY THE PRIVATE SECTOR UNDER DIRECT CONTRACT AND GOVERNMENT FRANCHISE BY REGION

| Type of Collection | Region | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Northeast | North Atlantic | Mid-Atlantic | South Atlantic | Mid-West | North Central | South Central | Mountain | West | Total |
| Distribution of Total Contractors | 5.3% | 20.2% | 6.4% | 3.7% | 23.9% | 16.0% | 5.1% | 3.9% | 15.5% | 100% |
| Share of Total Customers* | 5.2 | 16.7 | 6.5 | 6.3 | 22.5 | 6.6 | 4.7 | 2.1 | 29.4 | 100 |
| Residential Customers | | | | | | | | | | |
| Direct Contract | 3.2 | 9.2 | 4.2 | 8.5 | 32.8 | 11.1 | 1.4 | 3.8 | 25.8 | 100 |
| Government Franchise | 7.6 | 25.2 | 9.5 | 4.4 | 12.3 | 2.5 | 7.6 | 0.2 | 30.7 | 100 |
| Total Residential Customers | 5.4 | 17.2 | 6.9 | 6.5 | 22.6 | 6.8 | 4.5 | 2.0 | 28.2 | 100 |
| Commercial Customers | | | | | | | | | | |
| Direct Contract | 2.9 | 11.8 | 3.5 | 4.5 | 23.6 | 6.5 | 5.8 | 4.0 | 37.3 | 100 |
| Government | 1.8 | 1.0 | 2.2 | 4.7 | 1.0 | 0.2 | 15.3 | -- | 73.9 | 100 |
| Total Commercial Customers | 2.7 | 10.5 | 3.3 | 4.5 | 20.7 | 5.8 | 7.0 | 3.5 | 41.9 | 100 |

* Total Customers include industrial customers.

## TABLE 6.26

## PERCENT DISTRIBUTION OF CUSTOMERS SERVICED BY THE PRIVATE SECTOR UNDER DIRECT CONTRACT AND GOVERNMENT FRANCHISE WITHIN REGIONS

| Type of Collection | Region | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Northeast | North Atlantic | Mid-Atlantic | South Atlantic | Mid-West | North Central | South Central | Mountain | West | Total |
| Residential Customers | | | | | | | | | | |
| Direct Contract | 30% | 27% | 31% | 66% | 73% | 82% | 16% | 95% | 46% | 50% |
| Government Franchise | 70 | 73 | 69 | 34 | 27 | 18 | 84 | 5 | 54 | 50 |
| Total Residential Customers | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| Commercial Customers | | | | | | | | | | |
| Direct Contract | 92% | 99% | 92% | 87% | 99% | 100% | 73% | 100% | 78% | 87% |
| Government Franchise | 8 | 1 | 8 | 13 | 1 | 0 | 27 | -- | 22 | 13 |
| Total Commercial Customers | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |

# 7

## BUSINESS STRUCTURE

This chapter describes the business structure of the private sector of solid waste management. The management organization of the industry is discussed in terms of the relationship between business form (proprietorship, partnership, or corporation) and descriptors of contractor size. The age of the organization and the extent of involvement in other solid waste related businesses are also analyzed by contractor size.

This chapter is structured into the following subsections:

- Chapter Summary
- Business Structure by Size of Operation
- Age of Operation
- Other Solid Waste Related Businesses

## CHAPTER SUMMARY

Approximately one-half of the companies in the solid waste industry are operated as proprietorships, one-third as corporations, and ten percent as partnerships. Small contractors operate predominantly as proprietorships, and large contractors operate as corporations.

Nearly one-half of the companies in the private sector have been in their present organizational form since 1960, indicating an apparent ease of entry into the field. Data from previous chapters indicate that entry into the solid waste industry is most often through the development of an initial set of commercial customers rather than residential customers. This conclusion is supported by the fact that 44 percent of the contractors with 1-3 trucks serve commercial and industrial customers exclusively.

## BUSINESS STRUCTURE BY SIZE OF OPERATION

The type of ownership under which the private sector operates is related to the number of trucks, the number of employees, and daily tonnage. The following table indicates that companies organized as partnerships and corporations have higher mean numbers of trucks, employees, and tons per day than companies operated as proprietorships.

TABLE 7.1

MEAN NUMBER OF TRUCKS, EMPLOYEES, AND TONS PER DAY BY TYPE OF OWNERSHIP

| Type of Ownership | Number of Contractors | Mean # Trucks | Mean # Employees | Mean # Tons/Day |
|---|---|---|---|---|
| Total | 10,027 | 6.2 | 10.2 | 68.4 |
| Proprietorship | 5,631 | 2.8 | 3.7 | 20.1 |
| Partnership | 1,045 | 8.3 | 14.1 | 83.7 |
| Corporation | 3,351 | 11.3 | 21.1 | 150.7 |

The relationship of contractor size to type of ownership shows that smaller companies operate as proprietorships, and larger companies operate as corporations. Specifically, 79.6 percent of the companies operated as proprietorships are 1-3 truck contractors (Table 7.3). Proprietorships decrease in percent of companies from 84 percent among one-truck contractors to 7 percent among contractors with 50 or more trucks.

### TABLE 7.2

### NATIONAL ESTIMATE OF COMPANIES OWNED AS PROPRIETORSHIPS, PARTNERSHIPS, OR CORPORATIONS BY SIZE OF CONTRACTOR

| Type of Ownership | Size of Contractor | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 truck | 2-3 trucks | 4-5 trucks | 6-9 trucks | 10-19 trucks | 20-49 trucks | 50 or more trucks | Total |
| Total Contractors | 2,608 | 3,193 | 1,421 | 1,261 | 982 | 405 | 157 | 10,027 |
| Proprietorship | 2,185 | 2,297 | 732 | 315 | 73 | 22 | 11 | 5,631 |
| Partnership | 195 | 293 | 166 | 186 | 108 | 68 | 29 | 1,045 |
| Corporation | 228 | 603 | 523 | 760 | 801 | 315 | 117 | 3,351 |

### TABLE 7.3

### PERCENT OF COMPANIES OWNED AS PROPRIETORSHIPS, PARTNERSHIPS, OR CORPORATIONS BY CONTRACTOR SIZE

| Type of Ownership | Size of Contractor | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 truck | 2-3 trucks | 4-5 trucks | 6-9 trucks | 10-19 trucks | 20-49 trucks | 50 or more trucks | Total |
| Share of Total Contractors | 26.0% | 31.8% | 14.1% | 12.6% | 9.8% | 4.0% | 1.6% | 100% |
| Proprietorship | 38.8 | 40.8 | 13.0 | 5.6 | 1.3 | 0.4 | 0.2 | 100 |
| Partnership | 18.7 | 28.0 | 15.9 | 17.8 | 10.3 | 6.5 | 2.8 | 100 |
| Corporation | 6.8 | 18.0 | 15.6 | 22.7 | 23.9 | 9.4 | 3.5 | 100 |
| Total Contractors | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| Proprietorship | 83.8 | 71.9 | 51.5 | 25.0 | 7.4 | 5.4 | 7.0 | 56.2 |
| Partnership | 7.5 | 9.2 | 11.7 | 14.8 | 11.0 | 16.8 | 18.5 | 10.4 |
| Corporation | 8.7 | 18.9 | 36.8 | 60.3 | 81.6 | 77.8 | 74.5 | 33.4 |

Solid waste contractors who are proprietorships collect an average of 20 tons per day, while companies organized as corporations collect an average of 151 tons per day (Table 7.1). This point is further illustrated in Table 7.5, where 65 percent of the proprietorships collect less than twelve tons per day, while only 10 percent of the corporations collect twelve tons or less. Conversely, only 10 percent of those contractors who collect 1000 or more tons per day are proprietorships.

TABLE 7.4

NATIONAL ESTIMATE OF COMPANIES OWNED AS PROPRIETORSHIPS, PARTNERSHIPS, OR CORPORATIONS BY DAILY TONNAGE

| Type of Ownership | Number of Tons Collected Per Day | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1-6 | 7-12 | 13-24 | 25-49 | 50-99 | 100-249 | 250-499 | 500-999 | 1000 or more | Total |
| Total Contractors | 2,636 | 1,726 | 1,865 | 1,238 | 1,099 | 918 | 277 | 161 | 110 | 10,027 |
| Proprietorship | 2,383 | 1,273 | 1,143 | 467 | 248 | 96 | -- | 11 | 11 | 5,631 |
| Partnership | 117 | 245 | 186 | 195 | 117 | 108 | 39 | 29 | 9 | 1,045 |
| Corporation | 137 | 208 | 536 | 576 | 734 | 714 | 238 | 121 | 90 | 3,351 |

TABLE 7.5

PERCENT OF COMPANIES OWNED AS PROPRIETORSHIPS, PARTNERSHIPS, OR CORPORATIONS BY DAILY TONNAGE

| Type of Ownership | Number of Tons Collected Per Day | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1-6 | 7-12 | 13-24 | 25-49 | 50-99 | 100-249 | 250-499 | 500-999 | 1000 or more | Total |
| Share of Total Contractors | 26.3% | 17.2% | 18.6% | 12.3% | 11.0% | 9.2% | 2.8% | 1.6% | 1.1% | 100% |
| Proprietorship | 42.3 | 22.6 | 20.3 | 8.3 | 4.4 | 1.7 | -- | 0.2 | 0.2 | 100 |
| Partnership | 11.2 | 23.4 | 17.8 | 18.7 | 11.2 | 10.3 | 3.7 | 2.8 | 0.9 | 100 |
| Corporation | 4.1 | 6.2 | 16.0 | 17.2 | 21.9 | 21.3 | 7.1 | 3.6 | 2.7 | 100 |
| Total Contractors | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| Proprietorship | 90.4 | 73.8 | 61.3 | 37.7 | 22.6 | 10.5 | -- | 6.8 | 10.0 | 56.2 |
| Partnership | 4.4 | 14.2 | 10.0 | 15.8 | 10.6 | 11.8 | 14.1 | 18.0 | 8.2 | 10.4 |
| Corporation | 5.2 | 12.1 | 28.7 | 46.5 | 66.8 | 77.8 | 85.9 | 75.2 | 81.8 | 33.4 |

## AGE OF OPERATION

The mean number of years all contractors have operated their business in its present form is 13.9 years, with one-third of the businesses started since 1965, and over half started since 1960. The following table shows the number and percent of contractors who started their company in its present form for each time period.

TABLE 7.6

YEAR OF COMPANY ORIGIN IN PRESENT FORM

| Year Started | Total | Percent | Cumulative Percent |
|---|---|---|---|
| 1970-71 | 594 | 5.9% | 5.9% |
| 1965-69 | 2,729 | 27.2 | 33.1 |
| 1960-64 | 2,066 | 20.6 | 53.7 |
| 1950-59 | 2,574 | 25.7 | 79.4 |
| 1940-49 | 1,171 | 11.7 | 91.1 |
| Before 1940 | 831 | 8.3 | 99.4 |
| Don't know | 61 | 0.6 | 100.0 |

As would be expected, the contractors operating the most trucks, and those collecting the most tonnage have been in business in their present form the longest (Tables 7.7 and 7.8).

TABLE 7.7

PERCENT DISTRIBUTION OF YEAR BUSINESS STARTED IN ITS PRESENT FORM BY CONTRACTOR SIZE

| Year Started | Size of Contractor | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 truck | 2-3 trucks | 4-5 trucks | 6-9 trucks | 10-19 trucks | 20-49 trucks | 50 or more trucks | Total |
| 1970-71 | 9.3% | 4.1% | 5.6% | 7.1% | 3.0% | 4.9% | 0% | 5.9% |
| 1965-69 | 21.6 | 31.6 | 33.0 | 23.6 | 25.2 | 7.2 | 12.6 | 27.2 |
| 1960-64 | 19.0 | 17.7 | 21.8 | 22.8 | 31.3 | 24.4 | 12.5 | 20.6 |
| 1950-59 | 27.5 | 25.9 | 18.3 | 26.0 | 26.2 | 39.0 | 31.3 | 25.7 |
| 1940-49 | 11.6 | 12.6 | 12.7 | 11.0 | 5.1 | 12.2 | 12.5 | 11.7 |
| Before 1940 | 9.8 | 18.0 | 8.4 | 8.0 | 6.0 | 9.7 | 31.3 | 8.3 |
| Mean Years in Present Form | 14.6 | 13.7 | 13.6 | 14.5 | 12.8 | 16.6 | 23.9 | 13.9 |

## TABLE 7.8

### PERCENT DISTRIBUTION OF YEAR BUSINESS STARTED IN ITS PRESENT FORM BY DAILY TONNAGE

| Year Started | Number of Tons Collected Per Day | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1-6 | 7-12 | 13-24 | 25-49 | 50-99 | 100-249 | 250-499 | 500-999 | 1,000 or more | |
| 1970-71 | 5.5% | 7.2% | 6.0% | 5.7% | 7.3% | 3.3% | 0 % | 0 % | 9.1% | 5.9% |
| 1965-69 | 23.9 | 22.7 | 30.8 | 38.2 | 30.1 | 21.8 | 10.7 | 12.5 | 0 | 27.2 |
| 1960-64 | 18.4 | 17.9 | 19.1 | 19.5 | 18.2 | 34.8 | 32.1 | 37.5 | 18.2 | 20.6 |
| 1950-59 | 31.4 | 26.2 | 18.2 | 21.9 | 27.2 | 22.9 | 32.2 | 31.3 | 18.2 | 25.7 |
| 1940-49 | 12.2 | 13.7 | 14.8 | 8.1 | 9.1 | 9.8 | 10.7 | 6.3 | 18.2 | 11.6 |
| Before 1940 | 8.3 | 12.0 | 8.2 | 6.5 | 7.3 | 6.6 | 10.8 | 12.6 | 36.4 | 8.2 |
| Mean Years in Present Form | 14.5 | 15.5 | 14.3 | 11.5 | 12.6 | 14.7 | 17.0 | 15.3 | 26.4 | 13.9 |

Contractors in the West have been in their present form significantly longer (18.3 years) than contractors in other regions. The greater length of time contractors in the West have been in business is due to the fact that these contractors are, on the average, larger contractors (Table 7.9).

## TABLE 7.9

### PERCENT DISTRIBUTION OF YEAR BUSINESS STARTED IN ITS PRESENT FORM BY REGION

| Year Started | Region | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Northeast | North Atlantic | Mid-Atlantic | South Atlantic | Mid-West | North Central | South Central | Mountain | West | Total |
| 1970-71 | 4.2% | 5.7% | 9.1% | 9.1% | 2.7% | 8.1% | 8.6% | 2.1% | 7.5% | 5.9% |
| 1965-69 | 26.7 | 23.1 | 41.8 | 33.4 | 32.7 | 29.8 | 32.7 | 21.3 | 14.0 | 27.2 |
| 1960-64 | 28.2 | 20.9 | 10.9 | 24.2 | 20.0 | 21.0 | 25.9 | 21.3 | 19.4 | 20.6 |
| 1950-59 | 17.0 | 25.6 | 21.8 | 21.2 | 24.5 | 25.8 | 24.1 | 36.2 | 30.8 | 25.7 |
| 1940-49 | 12.7 | 14.1 | 12.7 | 9.1 | 10.5 | 11.3 | 6.9 | 12.8 | 11.9 | 11.7 |
| Before 1940 | 9.8 | 10.4 | 3.6 | 3.0 | 8.7 | 1.6 | 1.7 | 6.4 | 15.5 | 8.3 |
| Mean Years in Present Form | 14.7 | 15.3 | 11.1 | 10.2 | 13.7 | 11.6 | 9.5 | 13.7 | 18.3 | 13.9 |

## OTHER SOLID WASTE RELATED BUSINESSES

If several companies are located at the same address and if the records for all companies are combined, these companies are considered to be one establishment. On the other hand, if companies at the same address are run separately and separate financial books are maintained, each company is defined as an establishment. A total of 8,795 establishments own the 10,027 private contracting companies involved in collection, with each establishment operating a mean number of 1.14 collection and/or disposal organizations.

### TABLE 7.10

### NUMBER OF COMPANIES PER ESTABLISHMENT

| | Total | Mean Number Per Establishment |
|---|---|---|
| Total Establishments | 8.795 | |
| Number of Collection and/or Disposal Companies at "this" location | 9,704 | 1.11 |
| Number of Locations Operate From | 9,803 | 1.12 |
| Total Number of Collection and/or Disposal Companies | 10,027 | 1.14 |

As the following table indicates, 2.9 percent of the total establishments are subsidiaries of a parent firm and 3.1 percent of the establishments operate subsidiaries.

### TABLE 7.11

### NUMBER OF ESTABLISHMENTS WHICH ARE SUBSIDIARIES OF ANOTHER FIRM OR OPERATE SUBSIDIARIES

| | Number of Establishments | Percent of Total Establishments |
|---|---|---|
| Total | 8,795 | 100% |
| Establishments that are Subsidiaries | 293 | 2.9% |
| Establishments Which Operate Subsidiaries | 314 | 3.1% |

Over three-fourths of the total establishments are engaged in no other business except collection, but of those which are involved in other businesses, salvage operations and disposal sites were the most common.

TABLE 7.12

NUMBER OF ESTABLISHMENTS ENGAGED IN RELATED BUSINESSES

| Type of Business | Number of Establishments | Percent of Total Establishments |
|---|---|---|
| Total | 8,795 | 100% |
| None/No Other Business | 6,883 | 78.3 |
| Salvage Operations | 1,003 | 11.4 |
| Disposal Sites | 599 | 6.8 |
| Equipment Distribution | 377 | 4.3 |
| Land Development or Reclamation Company | 282 | 3.2 |
| Other Business | 221 | 2.5 |

The operation of related businesses is much more prevalent among establishments operating large collection companies. As Table 7.13 indicates, 89 percent of the one-truck companies have no other related businesses, while only 15 percent of companies with 50 or more trucks have no other related businesses. The percent of establishments engaged in other business increases as company size increases.

TABLE 7.13

NUMBER AND PERCENT OF ESTABLISHMENTS ENGAGED IN RELATED BUSINESSES BY SIZE OF ESTABLISHMENT

| Type of Business | Size of Contractor | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 truck | 2-3 trucks | 4-5 trucks | 6-9 trucks | 10-19 trucks | 20-49 trucks | 50 or more trucks | Total |
| Total Establishments | 2,287 | 2,797 | 1,240 | 1,108 | 862 | 352 | 141 | 8,795 |
| None/No Other Business | 2,037 | 2,402 | 964 | 771 | 496 | 200 | 21 | 6,883 |
| Salvage Operations | 230 | 264 | 136 | 153 | 93 | 42 | 85 | 1,003 |
| Disposal Sites | 9 | 55 | 91 | 145 | 164 | 81 | 55 | 599 |
| Equipment Distribution | -- | 63 | 45 | 72 | 117 | 45 | 36 | 377 |
| Land Development or Reclamation Company | 9 | 35 | 18 | 35 | 62 | 45 | 79 | 282 |
| Other Businesses | 25 | 34 | 34 | 34 | 51 | 34 | 8 | 221 |
| Total Establishments | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| None/No Other Business | 89.1 | 85.9 | 77.7 | 69.6 | 57.5 | 56.8 | 14.9 | 78.3 |
| Salvage Operations | 10.1 | 9.4 | 11.0 | 13.8 | 10.8 | 11.9 | 60.3 | 11.4 |
| Disposal Sites | 0.4 | 2.0 | 7.3 | 13.1 | 19.0 | 23.0 | 39.0 | 6.8 |
| Equipment Distribution | -- | 2.3 | 3.6 | 6.5 | 13.6 | 12.8 | 25.5 | 4.3 |
| Land Development or Reclamation Company | 0.4 | 1.3 | 1.5 | 3.2 | 7.2 | 12.8 | 56.0 | 3.2 |
| Other Business | 1.1 | 1.2 | 2.7 | 3.1 | 5.9 | 9.7 | 5.7 | 2.5 |

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